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PATENTS FOR INVENTIONS.

ABRIDGMENTS

OF

Specifications

RELATING TO

BRIDGES, VIADUCTS, AND AQUEDUCTS.

A.D. 1750–1866.

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PREFACE.

The Indexes to Patents are now so numerous and costly, as to render their purchase inconvenient to a large number of inventors and others, to whom they have become indispensable.

To obviate this difficulty, short abstracts or abridgments of the Specifications of Patents under each head of Invention have been prepared for publication separately, and so arranged as to form at once a Chronological, Alphabetical, Subject-matter, and Reference Index to the class to which they relate. As these publications do not supersede the necessity for consulting the Specifications, the prices at which the latter are sold have been added.

The number of Specifications at this time printed and published amounts to nearly 62,500. A large proportion of the Specifications enrolled under the old law, previous to 1852, embrace several distinct Inventions, and many of those filed under the new law of 1852 indicate various applications of the single Invention to which the Patent is limited. Considering, therefore, the large number of Inventions and applications of Inventions to be separately dealt with, it cannot be doubted that several properly belonging to the group which forms the subject of this volume have been overlooked. In the progress of the whole work such omissions will, from time to time, become apparent, and be supplied in second or supplemental editions.

The following series embraces all Inventions relating to the construction of bridges, viaducts, and aqueducts, whether formed of wood, stone, brick, or metal, or of concrete or composition; and in addition to those Inventions which are distinctly set forth as relating to such structures, certain other Inventions are included, which, although not so distinctly mentioned with reference to this particular subject, must nevertheless be considered as having a sufficient connection therewith to require notice in this work. These embrace certain Inventions relating to coffer-dams and other contrivances suitable for facilitating the construction of foundations under water, and also certain modes of forming arches, beams, and girders; of these such only are included as appear to be adapted or meant for use in the construction of bridges and aqueducts as well as other structures. The same observation applies to pile-driving, no Inventions relating to the latter being noticed except such as are specially mentioned with reference to the construction of bridges, viaducts, and aqueducts. It should be understood, indeed, that in the compilation of these works it has not been thought necessary or desirable to include in each series every invention which might by some possibility be made available with reference to the subject of that series. Thus there are a few inventions relating to concretes and cements which, although mentioned in the Specifications as being available in the construction of bridges, as well as other structures, are not included in this series, but will be found in the series relating to compositions and cements in general. So likewise as regards the manufacture of iron or steel plates, excavations for the foundations of bridges and other structures, and other inventions which, although relating in some degree to bridges and aqueducts, are more properly classed under the heads of the subjects to which they especially belong.

The Abridgments marked thus (* *) in the following pages were prepared for another series or class, and have been transferred therefrom to this volume.

B. WOODCROFT.

July, 1868.

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INTRODUCTION.

The construction of bridges, viaducts, and aqueducts requires a high degree of skill on the part of the architect and engineer, and in this art some of the greatest triumphs of human skill have been achieved.

There can be little doubt that the first bridges used were composed of the trunks of trees thrown across the stream or space to be traversed, this simple contrivance gradually giving way to others of a more elaborate and structural character. Of the progress made in the early ages in the construction of bridges there exists no reliable information prior to that found in the works of Herodotus, who describes a bridge which was erected over the Euphrates at Babylon, and which consisted of stone piers between which were arranged frames of wood, these being capable of removal at pleasure when it was desired to prevent the bridge from being used. The stones of the piers were fastened together by iron cramps soldered with lead, these piers being erected while the bed of the river was free from water, the latter having been diverted from its usual course into a large lake while the work was proceeding. Herodotus (i. 186) ascribes the building of this bridge to Nitocris; but Diodorus Siculus (who also mentions this structure) ascribes it to Semiramis.

Temporary bridges formed by laying platforms upon boats are also mentioned by Herodotus, who states that Darius at one time threw a bridge of this kind over the Thracian Bosphorus, and that a bridge was also constructed by order of Xerxes across the Hellespont. The latter was destroyed by a storm, but afterwards replaced; and from the description given by Herodotus it appears to have partaken of the nature of a suspension bridge, the platform or roadway of the bridge resting upon enormous cables formed by ropes of flax (λευκολίνου) and papyrus (βυβλίνων) twisted together, and maintained in a state of tension by windlasses (ὄνοι) on each side.

the Members of Parliament for the County of Durham, and displayed his desire to forward the interests of his constituents by not only exerting himself in procuring the Act of Parliament already mentioned, but by also furnishing the designs for the bridge, and subscribing the munificent sum of 22,000*l.* towards the cost of its erection. Mr. Burdon's contrivances in relation to this object formed the subject of a Patent, which was granted to him on the 18th of September, 1795, N° 2066, the main feature of his invention being the application of cast-iron blocks in the formation of the arch; a second Patent (N° 2635) being afterwards granted to him, in conjunction with a person named Wilson, for certain methods of connecting together such blocks. The elegance and boldness of the design of this bridge have been universally admitted. Other iron bridges were subsequently erected by Telford, and by Rennie; one of those contrived by the latter being the well-known Southwark Bridge, over the Thames; these being succeeded by various others, the Thames alone being now spanned by a number of iron bridges of various designs. The introduction of iron, indeed, as the material for bridges, has enabled structures of this class to be erected in situations in which it would have been impossible to construct a bridge of any other material; the adoption of the tubular system, moreover, having enabled such structures to be formed of a magnitude never before attained. For the idea which led to the introduction of this system we are indebted to the late Robert Stephenson, in the development of which, however, he had several able assistants, among whom Eaton Hodgkinson deserves to be specially mentioned.

The formation of aqueducts, as well as of bridges, was practised in a very early age. Probably the oldest record bearing upon this subject is that found in the 2nd Book of Chronicles, chapter 32, verse 30, in which we are told that Hezekiah "stopped "the upper watercourse of Gihon, and brought it straight down "to the west side of the city of David;" this work being also alluded to in the Book of Kings, and by the prophet Isaiah. Of the nature of this work, however, we have no information; nor have we much reliable information as to the construction of works of this class in the writings of any of the ancient historians previous to Herodotus, who mentions an aqueduct as being built by Pisistratus at Athens, one at Megara, and one formed by Polycrates at Samos (Herod. iii., 60). The Romans, however, greatly excelled the Greeks in the formation of aqueducts, some of their works of this class being of stupendous character. Frontinus tells us that previous to the year 313 B.C. the Romans had no structures of this nature, the River Tiber and the springs of the locality, along with cisterns for the reception of rain water, forming the sources from whence their supply of water was derived. Appius Claudius, the censor, began the first of their aqueducts, which was named, after him, the *Aqua Appia,* another viaduct being commenced afterwards by Curius Dentatus, which was subsequently known as the *Anio Vetus;* in both these cases the water proceeding partly underground and partly along a watercourse supported by arches. A third aqueduct was formed under the prætor Quintus Marcius Rex, and was known as the *Aqua Marcia,* and others were constructed by Augustus, and by Claudius, as well as by Trajan, some of these being works of great magnitude; one of those formed by Claudius being carried for about six miles of its course next to the city upon a continuous range of lofty arches, reaching in some places to a height of above 100 feet. Other works of this character were erected by the Romans in the countries they had subdued; as, for instance, at Ephesus, Smyrna, Lyons, and Segovia; some of these being structures of great size and stability. In most of these erections the actual channel (*specus*) for the passage of water was formed of stone or brick, and lined with cement, being arched over to exclude the heat of the sun, but furnished with vent holes for the circulation of air; and where the height of the channel above ground was considerable it was in many cases supported by several tiers of arches placed one above another.

We are informed by Suetonius that during the republic the censors and ædiles had the superintendence of the aqueducts, but that under the emperors officers called *curatores* or *præfecti aquarum* were appointed by them to that duty; these officers being invested with considerable authority, and being attended when on duty outside the city by two lictors, three public slaves, a secretary, and other servants; and at one time these officers appear to have had also under their control no less than five classes of subordinates directly connected with the works; these being, 1st, the *villici,* who attended to the aqueducts in their course outside the city; 2nd, the *castellarii,* who had charge of all the reservoirs; each aqueduct having a reservoir at each end as well as others intermediate of these; 3rd, the *circuitores,* who seem to have acted as watchmen or overseers; 4th, the *silicarii*, or paviours; and, 5th, the *tectores*, or plasterers; all these officials, however, being included under the general term *aquarii*.

The aqueducts of the Romans were indeed the greatest works of the kind the world ever saw, but it is of course obvious that much of the labour they bestowed upon them might have been spared had they possessed a better knowledge of the science of hydrostatics, and the stately tiers of arches, with the superincumbent watercourses, have found an efficient and economical substitute in the shape of pipes laid underground. Modern science has rendered such works unnecessary, except in cases in which it is desired to carry a navigable stream across some open space or chasm, and as these cases are not of frequent occurrence the construction of an aqueduct has now become a somewhat rare event. To James Brindley the honour is due of having constructed the first aqueduct seen in this country, and the subject has occupied the attention and called forth the ingenuity of no small number of others since his day, as will be seen on inspecting the body of this work.

BRIDGES, VIADUCTS, AND AQUEDUCTS.

BRIDGES, VIADUCTS, AND AQUEDUCTS.

A.D. 1750, March 13.—N° 654.

DENT, Isaac.—" A method of making terras," suitable "for " building bridges and wharfs," and useful in all other cases where it is necessary " to build in or fence against the water."

The Specification of this invention is as follows:—

"Take freestone and burn it in a kiln or furnace till it becomes " like a body of fire, then take it out and cool it, and then grind " it in a mill till it becomes a fine powder, and then skreen or sift " it through a fine skreen or sieve to separate the fine stuff from " the hard lumps which the mill cannot easily break, and then " the same becomes terras; or (where such freestone is scarce, or " becomes too dear to answer the end, and cannot be had at a " moderate expense), mix fine light loam or clay with water, and " work it up into a substance, and lay it out to dry and harden in " the sun and wind till it becomes hard almost like a stone, then " burn it in a kiln or furnace, and grind, skreen, or sift it in the " very like manner as above directed when it is made with " freestone."

[Printed, 4*d*. No Drawings.]

A.D. 1788, August 26.—N° 1667.

PAÎNE, Thomas.—" A method of constructing of arches, vaulted " roofs, and ceilings, either in iron or wood, on principles new " and different to anything hitherto practiced, by means of which " construction arches, vaulted roofs, and ceilings may be erected " to the extent of several hundred feet beyond what can be performed in the present practice of architecture."

" The idea and construction of this arch is taken from the " figure of a spider's circular web, of which it resembles a section, " and from a conviction that when nature empowered this insect

" to make a web, she also instructed her in the strongest mechani-
" cal method of constructing it."

"Another idea, taken from nature, in the construction of this
" arch, is that of increasing the strength of matter by dividing and
" combining it, and thereby causing it to act over a larger space
" than it would occupy in a solid state, as is seen in the quills of
" birds, bones of animals, reeds, canes, &c. The curved bars of
" the arch are composed of pieces of any length joined together
" to the whole extent of the arch, and take curveture by bending.
" Those curves, to any number, height, or thickness as the extent
" of the arch may require, are raised concentrically one above
" another and separated, when the extent of the arch requires it,
" by the interposition of blocks, tubes, or pins, and the whole
" bolted close and fast together (the direction of the radius is the
" best) through the whole thickness of the arch, the bolts being
" made fast by a head pin or screw at each end of them. This
" connection forms one arch rib, and the number of ribs to be
" used is in proportion to the breadth and extent of the arch, and
" those separate ribs are also combined and braced together by
" bars passing 'cross all the ribs, and made fast thereto above and
" below, and as often and wherever the arch, from its extent,
" depth, and breadth, requires. When this arch is to be applied
" to the purpose of a bridge which requires more arches than one,
" they are to be connected in the following manner (that is to
" say):—Wood piles are to be driven into the earth; over each of
" those piles are to be let fall a hollow iron or metal case, with a
" broad foot let into a bed; the interspace between the case and
" the wood pile to be filled up with a cement and pinned toge-
" ther. The whole number of those pillars are to be braced
" together, and formed into a platform for receiving and connect-
" ing the arches. The interspaces of those pillars may be filled
" with plates of iron or latticework so as to resemble a pier, or
" left open so as to resemble a colonade of any of the orders of
" architecture. Among the advantages of this construction is
" that of rendering the construction of bridges into a portable
" manufacture, as the bars and parts of which it is composed
" need not be longer or larger than is convenient to be stowed in
" a vessel, boat, or waggon, and that with as much compactness
" as iron or timber is transported to or from Great Britain; and
" a bridge of any extent upon this construction may be manu-
" factured in Great Britain and sent to any part of the world to

" be erected. For the purpose of preserving the iron from dust " it is to be varnished over with a coat of melted glass. It ought " to be observed, that extreme simplicity, though striking to the " view, is difficult to be conceived from description, although such " description exactly accords, upon inspection, with the thing " described. A practicable method of constructing arches to several " hundred feet span, with a small elevation, is the desideratum of " bridge architecture, and it is the principle and practicability of " constructing and connecting such arches so as totally to remove " or effectually lesson the danger and inconvenience of obstructing " the channel of rivers, together with that of adding a new and " important manufacture to the iron works of the nation, capable " of transportation and exportation, that is herein described. " When this arch is to be applied to the purpose of a roof and " ceiling, cords may be added to the arch to supply the want of " butments, which are to be braced to or connected with the arch " by perpendiculars."

[Printed, 4d. No Drawings. See Rolls Chapel Reports, 6th Report, p. 144.]

A.D. 1795, April 14.—N° 2046.

CARTWRIGHT, Edmund.—" A new principle on which bricks, " stones, or any other building materials which may be substitued " for those articles, may be so formed as to be applied with " peculiar advantage in the erection of walls and in the construc- " tion of arches."

This invention consists " in giving bricks, stones, or any other " building materials which may be substituted for those articles, " such a shape or form as that (when in work) they shall mutually " lock into or cramp each other." The patentee states that the principle of the invention will readily be understood " by sup- " posing the two opposite sides of a common brick to have a " groove or rabbet down the middle, which groove or rabbet must " be a little more than half the width of the side of the brick in " which it is made; there will then be left a shoulder on each " side of the groove or rabbet, each of which shoulders will be " nearly equal to one quarter of the width of the side of the brick, " or to one half of the groove or rabbet." A course of these bricks being laid shoulder to shoulder " they will form an indented " line of nearly equal divisions, the grooves or rabbets being " somewhat wider than the two adjoining shoulders to allow for

" mortar, &c.; when the next course comes on the shoulders of " the bricks which compose it will fall into the grooves or rabbets " of the first course," and the shoulders of the first course will fit into the grooves or rabbets of the second, and so on.

Different modifications of the invention are described, and the patentee states that it may make some small saving in the expense of an erection thus constructed, "though, perhaps, not a prudent " one," if the bricks, &c., "were of such a width as to admit a " common brick or piece of plain stone, &c." between their shoulders.

In bricks intended for the construction of arches "the sides of " the grooves or rabbets and the shoulders should be radii of the " circle of which the intended arch is to be a segment." "Though if the circle be very large the difference of the width of " the bricks, &c., at top and bottom will be so trifling as to make " a minute attention to this particular scarcely, if at all, necessary. " When these arches are required to be particularly flat, or are applied in such situations as admit not of end walls, as in the construction of bridges, &c., it may be expedient to have the shoulders " dovetailed, to prevent the arch cracking across or giving way " endwise." The bricks, &c., may be either laid in mortar, or laid dry and the interstices between them be filled up by pouring in lime, plaister of Paris, or any other convenient material.

[Printed, 6*d*. Drawing. See Repertory of Arts, vol. 3, p. 84; and Register of Arts and Sciences, vol. 2, p. 305.]

A.D. 1795, September 18.—N° 2066.

BURDON, ROWLAND.—"A certain mode or manner of making, " uniting, and applying cast-iron blocks to be substituted in lieu " of keystones in the construction of arches, the said cast-iron " blocks being kept in their proper position, and made to abut " against each other, and to support any incumbent structure by " means of wrought-iron bars, and wrought or cast-iron braces " being affixed to their sides, and passing horizontally between " ribs composed of the said cast-iron blocks."

This invention relates to "applying iron or other metallic " compositions to the purpose of constructing arches upon the " same principle as stone is now employed, by a subdivision into " blocks easily portable, answering to the keystones of a common " arch, which being brought to bear on each other gives them all " the firmness of the solid stone arch, whilst by the great vacui-

" ties in the blocks and their respective distances in their lateral " position, the arch becomes infinitely lighter than that of stone, " and by the tenacity of the metal the parts are so intimately con- " nected that the accurate calculation of the extrados and in- " trados, so necessary in stone arches of magnitude, is rendered " of much less consequence."

These blocks are not solid, but each block is composed of a kind of frame or ribbed structure, a number of these being united by "bar iron" passing along recesses in the blocks, and connected thereto by bolts. The structure is also strengthened "laterally" by the employment of tubes bolted thereto. " The " blocks being united with each other in ribs, and the ribs con- " nected and supported laterally by the tubes, as above de- " scribed, the whole becomes one mass, having the property of " keystones cramped together."

The blocks and tubes described in this Specification are mentioned as being intended for use in the construction of a bridge by the patentee "across the River Wear at Wearmouth, " near Sunderland, in the county of Durham."

[Printed, 6*d.* Drawing. See Repertory of Arts, vol. 5, p. 365.]

A.D. 1796, May 24.—N° 2109.

JORDAN, JAMES.—" Certain new improvements in the building " and constructing of bridges, aqueducts, and various public and " private buildings, and which may also be applied to other " useful purposes."

This invention is described chiefly as relates to bridges and aqueducts, the patentee mentioning that certain of the arrangements may also be applied in covering-in large buildings and " other erections." The whole of the arrangements are on what is understood as the suspension system. In constructing a bridge, two curved ribs formed of timber and iron are employed, these resting on piers or abutments on each side of the river or place to be crossed. One curved rib is placed on each side of the erection, and each sustains, by means of vertical suspending bars, a horizontal rib, also formed of timber and iron, one for each side of the roadway of the bridge, there being laid on these ribs first of all girders or cross beams about six feet apart, then upon these longitudinal beams, and upon the latter, again, planks laid crosswise, on which gravel or ballast may be placed as may seem most desirable. The whole of these parts are securely bound together by bolts and iron plates, the girders, however, being each laid in a "box mortise" at one end, and a "pulley mortise" at the other, so as to be easily fixed and removed at pleasure. Footways may be constructed so as to project beyond the horizontal ribs of the bridge, by the use of a "bottom bar," a "side bar," and a "brace bar," connected to each suspending bar in the form of a triangle with the base upwards, the bases of these triangles sustaining planks for the footways and their outer railings.

When it is necessary to apply a drawbridge to a bridge of this construction, in order to allow of the passage of vessels with masts, the central portion of the horizontal platform is so constructed as to be raised in two parts, each of these parts being capable of turning on a fulcrum at the portion furthest from the centre of the bridge. In this case these moveable portions are sustained when in the horizontal position by chains instead of bars, other chains or weights being used to raise these portions when necessary. Various arrangements of these chains and weights may be made. In order to preserve the parts of the bridge immediately over the moveable portions securely in position, the suspending bars next to them are connected and stayed by iron framework. "As a counterbalance for the separation of the bridgeway "(if only of one arch) the ends of it are to go the further "on the buttresses," and be stayed by iron bars in such buttresses, and chain bars laid in them, but where more than one arch is used, "additional suspending ribs" are used in place of this arrangement.

In forming an aqueduct, cast-iron curved ribs are used, composed of a number of smaller ribs bolted together, these curved ribs sustaining by means of vertical bars certain horizontal ribs, on which are formed the bottom and sides of the aqueduct, these being constructed of wood, metal, or both combined. A "horse "and footpath" passes along one side of the aqueduct, this being formed on the same system as the footpaths already described. The upper portions of the sides of the aqueduct may be so planked or constructed as to touch the suspending bars, by which means the bars will prevent the sides from being forced outwards by the lateral pressure of the water. The horse or towing path may be either inside the suspending bars or outside the latter; but when outside it will be necessary to pass a towing rope from one end of the aqueduct to the other, in order to draw the boats across, the bars preventing the rope from being used in the ordinary manner.

In applying the invention to the covering-in of buildings, similar arrangements may be used "to those proposed for the sus-" pending of bridges and aqueducts," with such modifications as the nature of the case may require.

[Printed, 1*s.* 2*d.* Drawing. See Repertory of Arts, vol. 6, p. 220.]

AD. 1797, February 7.—N° 2165.

NASH, John.—" A new and peculiar art or method of construct-" ing bridges of plate iron, either wrought, cast, frame, or put " together so as to form hollow bodies, masses, or cubes, capable " of being filled up with earth, sand, stone, gravel, or other ma-" terials to make the same solid bodies, masses, or cubes, or not " being filled have the semblance of solid bodies, masses, or cubes."

" The arch of the bridge is formed by hollow frames or boxes, " each box consisting of four sides and a bottom. The sides " form the arch joints of the bridge, and are diminished so as to " tend to the centre of the circle, which strikes the arch in such a " manner that when these boxes or frames are put together side " by side, they form the arch of the bridge, the joints of which " have a solid bearing throughout, like those of stone bridges. " These boxes are afterwards filled with earth, clay, or sand, or " gravel, or gravel mixed with lime, or sand mixed with lime, or " rough stone, or rough stone masonry, or bricks, or freestone, " or any other substance, so that when filled the arch is one body " cased with iron." These boxes may be made of cast iron or wrought iron, " may be cast, rolled, or hammered in flat plates " and frames, and put together. They may be cast without " bottoms, and the bottoms put in," or they may be cast with bottoms, or " they may be used without bottoms or filling-up, " and be boarded or plated over at top, and the road filled in." One part of the " principle of this patent " is mentioned as being " the abuttal of plates of iron throughout the breadth of the " bridge in the manner of the arch joints of a stone bridge." Or the boxes " may be a succession of arches with flanches form-" ing the arch joints," and " filled up in the spandrils, or not " filled up, or they may be formed of hollow cylinders with " flanches." " These arch joints may have sheet lead or other " composition placed between them to fill up the uneven sur-

" faces of the iron, to prevent the pressure of iron against iron." The arch joints or flanchings may be screwed together, " or stubb " tenants or fillets, with correspondent holes, mortices, and " grooves, may be cast in the plates themselves, and fitted into " each other." The " skirting or kirb which keeps in the ground " may either be formed along with the boxes, or constructed separately, or may be entirely dispensed with. When several arches are put together, the spaces between them are formed by hollow spandrils of iron, framed, cast, or put together as before-mentioned, which may be fitted up or otherwise, and may be cylindrical, triangular, or of many sides. The piers of the bridge are formed hollow, and cylindrical, triangular, quadrangular, or of many sides, as in the case of the spandrils, and filled up or not as most desirable. " The dam is also formed hollow by piles of " plate iron grooved, rebated, and dovetailed into each other, " which, when fixed into each other, form a hollow box, and when " driven or inserted into the bed of the river form a dam for the " pier," and when the pier is built, are driven home into the bed of the river, making "a box of dovetailed piles enclosing the " ground on which the pier stands, and securing it from being " undermined by the water passing through the arch."

[Printed, 1*s*. 8*d*. Drawings. See Repertory of Arts, vol. 6, p. 361.]

A.D. 1800, June 10.—N° 2410.

WYATT, SAMUEL.—" A new arch, or method of making and " constructing bridges, warehouses, and other buildings without " the use of wood as a necessary constituent part thereof, and " with other advantages and improvements appertaining thereto."

The patentee says,—" the principle or nature of my invention, " and the manner of performing the same in regard to bridges, " consists in using or applying pipes, tubes, or other hollow " pieces of cast iron in a longitudinal direction, and plates or " pieces of the same material having sockets on them to receive " the ends or shoulders of the said pipes, tubes, or other hollow " pieces, placed transversely, and extending from one side of the " bridge to the other, so that, when the required number of pipes, " tubes, or other hollow pieces of cast iron and of transverse " plates or pieces are put together, they form the arch, and so " firmly fix, connect, and unite all the parts as not to require the " aid of screws, bolts, cramps, or any wrought-iron fastening

" whatever; but for the sake of giving the joints a more equal " bearing it will be proper to run lead or cement into them. The " manner of covering the ribs, and of fixing the battlements or " ballustrades, as well as the form and design of each, may be " varied at the discretion of the builder, but I prefer the follow- " ing :—After having fixed the ribs of the arch agreeably to the " above principle, and run the arch joints with lead or cement, as " above-mentioned, I then fix the plinths on the outside ribs of " the arch, which plinths are afterwards secured in their places " by the standards of the battlements or ballustrade. I then " cover the ribs with cast-iron plates to receive the gravel " and pavement, as well as the battlements, ballustrade, or parapet " of the bridge. These plates I make of an arched shape, for " the sake of additional strength, and place them so that their " sides are supported by the ribs of the bridge as abutments. I " next fix the standards, and the pannels of the ballustrades or " battlements, the standards being made or cast with grooves on " each side to receive the said pannels, and a branch or plate at " right angles, to be secured under the foot pavement. The top " of the said standards are formed with dovetailed plugs to be " inserted in the rail. The whole is then firmly united by the top " rail, which is also made with a groove in it to receive the top of " the pannel of the battlement. It will then be proper to run " with lead or cement those parts which require it. For the " greater security of the standards I recommend the foot pave- " ment to be joggled, which will have also the effect of keeping it " even on the top."

" Secondly, the principle or nature of my said invention, in " regard to warehouses and other buildings, consists in forming " arched ceilings of cast iron, and supporting them and the floors " by hollow pillars, cylinders, tubes, or pipes of the same " material."

" The spandrels of the arches of the ceilings may be filled and " raised to a level with the crown of the arches by brickwork, " chalk, or any solid matter, upon which may be laid either stone " or brick pavement, or boards if required, for the floors."

[Printed, 1*s*. 8*d*. Drawings. See Repertory of Arts, vol. 14, p. 145.]

A.D. 1802, July 23.—N° 2635.

WILSON, Thomas, and **BURDON**, Rowland.—" Certain " new methods of uniting, combining, and connecting the

" metallick patent blocks of the said Rowland Burdon for the " construction of arches."

This invention relates to improvements upon the invention for which a patent was granted to Rowland Burdon on the 18th of September, 1795 (No. 2635). The improvements are thus set forth :—

" First, instead of uniting the blocks by bar iron on the out- " side of the arms and bolts fasten'd with cotterels or forelocks, " as described in the Specification of the said Rowland Burdon's " invention, inrolled in His Majesty's High Court of Chancery, " the Tenth day of October One thousand seven hundred and " ninety-five, my method is to insert dowels or slots into the ends " of the arms of the blocks at the points of bearing, and to bring " the blocks into close contact by driving wedges through the " blocks and dowels or slots, thereby combining the component " parts of each rib in a more firm and substantial manner than " has heretofore been practised, and considerably diminishing the " drift or thrust of the arch."

" Secondly, instead of connecting and combining the ribs by " means of hollow tubes, as described in the said Rowland Bur- " don's said Specification, my method of connecting and combin- " ing the ribs is by introducing between the blocks at the points " of bearing cross bars from rib to rib, with apertures therein of " sufficient size to admit the dowels or slots which connect or " combine the blocks together to pass through the same, by which " means the ribs are kept in their required position ; and the " blocks do not bear against each other, but are kept in close con- " tact with the cross bar against which they abut, and are con- " nected together by the dowels or slots and wedges."

[Printed, 6*d.* Drawing. See Repertory of Arts, vol. 3 (*second series*), p. 87.]

A.D. 1807, June 26.—Nº 3055.

PALMER, John.—" A new method of constructing and erecting " bridges."

The Specification of this invention is as follows :—

" 1st.—The abutments of proper materials, as in the construc- " tion of common bridges, inclosing a bar or beam of cast iron of " sufficient strength and thickness to bear the weight intended, " and so secured as to prevent the possibility of its giving way. " 2ndly.—The piers or supporters are to be of cast iron, erected

" on platforms or bases of cast iron resting on rocks or other
" hard materials. These supporters may be formed of ten, fifteen,
" or any number of cast-iron columns, according to the width of
" the bridge, and the weight they are intended to bear, with two
" or more cast-iron stays to go from each of these columns into
" the platforms or bases, one large cast-iron beam or more to rest
" on the top of the columns, so as to unite the whole together,
" and sufficiently stout. There may be many piers or supporters
" formed in this way, proportioned in height with and strength to
" the design of the architect; or the piers may be made of stone
" or brick as in other bridges. 3rdly.—From the abutments to
" the piers or supporters, and from one of these to another,
" chains must be passed, made of iron, brass, copper, or any other
" metallic substance. These chains may be either flat, circular, or
" oval, or of any other construction, and must be placed parallel
" with each other, and drawn to the same degree of tightness.
" If they swag, iron or other metal rods should be passed through
" at proper distances, like basketwork, which will brace them,
" and being properly braced and fastened (after having been first
" proved), form a support for the roadway. 4thly.—On these
" chains planks are to be laid of about eight inches wide and four
" thick. These planks should be fastened to each other with
" hinges or rings, which would keep them in their places, and yet
" allow them to move properly with the chains; or rather the
" passage from one pier or set of supporters to another may be
" made in this way:—Let flat chains be formed of hinge work
" from about four to twelve inches long, sufficiently strong and
" proved. These are to be laid as chains, and the planks fastened
" to them as in common door work. A road may be made by
" these means that would bear any weight. 5thly.—The guard
" or side fences of the bridge may be well formed by fixing chains
" of any construction sufficiently strong from one upright to
" another, placed on the top of the piers or supporters, and, if
" thought necessary, placing iron wire against them on the inside
" of about nine or ten feet high. Bridges on this plan may be
" so constructed as to take down and replace at pleasure with very
" little trouble or expence, and may be repaired with the greatest
" care when found necessary."

[Printed, *4d.* No Drawings. See Repertory of Arts, vol. 11 (*second series*), p. 329; and Rolls Chapel Reports, 7th Report, p. 194.]

A.D. 1807, July 28.—N° 3064.

PHILLIPS, John.—This invention relates to the construction of moveable bridges, cottages, and other erections, and is also applicable in the construction of desks, drawing boards, and other articles.

In the construction of a bridge, pieces of "square baulk" are used for the sides, these being connected by an upper and a lower range of transverse beams, the beams forming the sides being vertical, and the transverse beams being connected to them by projections at their ends of dovetailed form, which enter into recesses in the sides formed to receive them. The beams forming the sides are also connected by similar means. The floor of the bridge is laid upon the upper range of transverse beams, these beams being further sustained by vertical beams passing between their lower sides and the upper sides of the lower beams, the vertical beams having dovetailed projections at their ends, which enter into corresponding recesses in the transverse beams.

In the erection of a moveable cottage, timber is used, the beams, boards, &c. being connected by dovetailed joints, and the whole structure being, if desirable, raised from the ground upon posts, a flight of steps giving access to the interior. The roof may be covered with slates or tiles, laid in mortar (the roof being first boarded), the slates or tiles being secured by nails, and pointed with a composition formed of a mixture of pulverized lime or other stone, fine sand, and linseed oil. Or the slates or tiles may be placed upon rafters and laths, and secured by nails or pins, and then pointed on the inside with mortar, and the outside with the composition already mentioned. If the tiles are to be nailed upon boards, they are furnished with ears at two opposite corners, having holes through them, but if they are to be hung on laths they are furnished with knobs on their lower sides. The tiles are furnished likewise with grooves in the top and bottom edges, which will prevent "the wet being blown "inside." The sides of the erection may be also covered with tiles, or may be coated with the composition only. When more than one story is required, the floors of the upper stories may be covered with tiles on the same system as the roof, and the floors and roof may be strengthened, if necessary, by pillars inside the structure, having cross beams passing from one to another. The doors and windows are hung (by preference) outside, in order more effectually to keep out the rain, projecting pieces of wood being placed over each door and window for a similar purpose, the projecting pieces being grooved underneath to "to carry off "the wet," and other projecting pieces being placed where desirable to preserve the structure from the access of moisture.

Small erections, to be used as sentry boxes, &c. may be furnished with wheels, so as to be readily turned or moved. Larger erections may either be taken to pieces before being moved, or be removed in a whole state. In the latter case, the structure is raised upon a carriage furnished with wheels, and drawn along boards or rails by a windlass mounted on a portable frame contrived for the purpose.

The composition mentioned above as applicable to the pointing of roofs, &c., is termed by the patentee "Phillips' patent "weatherproof coating or composition for the roofs and fronts "of houses, &c."

The Specification of this invention is of considerable length, and includes a variety of details relating to the construction of desks, tables, drawing boards, drawing squares (which may be converted into plumb rules), office seats, office candlesticks, painters' easels, and the carriages of cannon, but none of these details have any bearing whatever upon the subject of the present series of abridgments.

[Printed, 10*d.* Drawing. See Rolls Chapel Reports, 7th Report, p. 199.]

A.D. 1808, June 3.—N° 3141.

DODD, RALPH.—"Improved bridge floorings or platforms, and "fireproof floorings and fireproof roofings for extensive dwelling "houses, warehouses, and mills."

This invention relates to a certain method of applying malleable iron and other metals in combination with condensed earth or artificial stone in the construction of bridges, and for other purposes.

In one modification of the invention a "tubical rib" is employed, which is "either to be used empty or filled, or part "filled with condensed earth or artificial stone, or to be coated "outside with the same, to be made of any figure from the circle "to the square, and to be applied from one pier to another, or

" bearings, either straight, eliptical, triangular, or forming a " segment or circle." Another modification of the invention relates to " an upright shaft or column for sustaining heavy " weight, strengthened internally or externally with condensed " earth or artificial stone," and which " is either filled wholly or " in part." These shafts or columns may be formed with " flanges or joints for attaching one to each other," and may be, if desired, used in a horizontal position, and either for sustaining pressure or as pipes. These articles may be either of cylindrical form, or of square section, and in the latter case may be employed as beams, piles, girders, &c., being furnished if necessary with ears or flanges for facilitating the fastening of timber or other articles thereto, and these ears being so arranged as to be adapted for the reception of " metal plates or materials," either in " horizontal segments or eliptical forms," suitable for the arches of bridges, fire-proof roofs, and other constructions. Cylindrical tubes thus formed may also be used for the masts and yards of ships, and modifications of the invention may be applied in the construction of vessels, either for floating upon or for containing water or other liquids.

The patentee apparently intends that in all cases the tube or beam shall be in the first place formed of metal, and then coated, lined, or filled with the condensed earth or artificial stone, or otherwise, according to the requirements of the bridge or structure in which they are to be used. It is not clear whether the " tubical " rib " first mentioned, and which is merely represented in the drawing annexed to the Specification by a small figure, shewing part of a curved tube of square section, is meant to be of such size as to form a complete arch for a bridge, or whether a number of such tubes are to be combined together.

[Printed, 6*d*. Drawing. See Repertory of Arts, vol. 14 (*second series*), p. 145; and Rolls Chapel Reports, 7th Report, p. 107.]

A.D. 1811, March 4.—N° 3405.

GUPPY, Sarah.—" A new mode of constructing and erecting " bridges and railroads without arches or sterlings, whereby the " danger of their being washed away by floods is avoided."

This invention is thus described:—

" On each side of the river or place over which a bridge or road " is to be constructed, pursuant to my said invention, I do fix or " drive a row of piles, with suitable framing to connect them

“ together, and behind these I do fix or drive and connect other
“ piles or rows of piles and suitable framing; or otherwise, upon
“ the banks of the said river or place, I do dispose or build
“ certain masses of connected masonry or other ponderous
“ structures, with piles or without, in order and to the end that
“ the said piles or masonry, or other structures, shall be capable
“ of sustaining and permanently resisting the action of a con-
“ siderable force, applied or exerted in directions tending to bring
“ the same together; and I pass across the said river or place,
“ from the upper or other convenient part of the said piles or
“ masonry or structure, several strong metallick chains, parallel
“ to and at suitable distances from each other, which said chains
“ may be drawn tight by secure mechanical means; or otherwise
“ the said chains may be suffered to hang in similar lines, slightly
“ curved from the one side or bank to the other, and in either
“ case I do dispose upon the said chains, longitudinally and
“ crosswise, such fit pieces of timber or iron, or other suitable
“ material, as shall and may constitute a platform, which by the
“ connection or disposition of the materials thereof, shall afford
“ a proper support for a road or pavement of the usual structure,
“ or for railroads, which last, namely, the railroads, upon such
“ occasions as may require the use and application of my said
“ invention, I do connect, unite, and frame together with each
“ other and with the chains herein-before mentioned and
“ described.”

[Printed, *4d.* No Drawings. See Repertory of Arts, vol. 19 (*second series*), p. 215; and Rolls Chapel Reports, 8th Report, p. 83.]

A.D. 1811, April 2.—N° 3429.

BENTHAM, SAMUEL.—“A secure œconomical mode of laying
“ foundations, and in some cases of proceeding with the super-
“ structure of works of stone, or of brick or other artificially
“ composed materials, particularly applicable to the projection of
“ wharfs and piers into deep water, to the construction of bridges,
“ and the formation or improvement of harbours, as well as to
“ the erection of heavy buildings on bad ground.”

According to this invention hollow masses of brickwork, stone, or other suitable material, united by Roman or other cement or mortar, are employed, which after being duly prepared are sunk down into water (in the case of marine structures), thus constituting hollow columns or pillars, which are pressed down into the ground below the water by bringing over each of them at high tide a loaded vessel, which vessel at the fall of the tide will rest upon and press down the column or pillar as required. Other modes of pressing down the columns may, however, be adopted, and the water being then pumped out from the interior thereof, the latter may be filled up, either partially or wholly, with suitable material, and if necessary other similar columns placed or built upon the first, or a superstructure raised thereon by ordinary means. A combination of columns thus formed and arranged side by side, will answer for a "wharf wall," the columns being deposited in their places in succession, and maintained in their relative positions by there being a groove on one side of each column into which a projection from the next column enters; or by both sides being grooved and pieces of timber inserted into the grooves, which on the settlement of the columns in their places are removed, and the grooves filled up with "brickwork and "grout" or other material. If not filled up the interiors of these columns may serve as cellars or store rooms. Columns thus formed may be arranged to serve as breakwaters, a number of them being for that purpose placed at some distance apart, and in two or more rows, the columns of one row opposite the spaces between the next, so as to "form a complete impediment to the direct "action of the waves," and yet allow the passage of the tide or current. These columns may support other masses laid upon them, and reaching from one to another, and having the side next the open sea of a sloping form, while the other is perpendicular. The piers of bridges are constructed of columns having the forms of the masses varied to suit the style of pier desired. And when the bridge is to serve the purpose of a dam, with a sluice or lock between the piers, masses are constructed so as each to constitute a part of the pier, and also a part of the bottom of the sluice or lock, these when put together forming at the lower part "an "inverted arch or otherwise." To these constructions may be added temporary ends for the purpose of keeping out the water until the masses are settled in position, which temporary ends may consist of "floating dams," which may be removed and replaced at pleasure. This arrangement may also be applied in the construction of sluices or locks apart from bridges, and also of dry docks.

Embankments and other similar structures may also be formed on this system, if necessary, the masses used for such purposes being either filled up, or left hollow and used as store rooms or habitations. The masses may, however, be, if desirable, formed solid in the first instance, and may be of any shape and size required, strengthened, if needful, by "ties" of wood or metal. Where it is desirable to combine lightness with strength the cellular form of construction may be adopted.

For the foundations of buildings "on bad ground" a system is adopted similar to that described with reference to wharf walls, &c., the columns being pressed into the ground until a sufficiently solid bearing is obtained, such columns being then connected, if desirable, by arches, and the superstructure raised thereon.

[Printed, 10*d.* Drawing. See Repertory of Arts, vol. 20 (*second series*), p. 1; and Rolls Chapel Reports, 8th Report, p. 85.]

A.D. 1812, January 15.—N° 3516.

KELLY, Jasper Augustus, and VAZIE, Robert.—"Certain "improvements in the construction or formation of arches and "other erections and buildings," which, in respect to the patron of the invention, the patentees denominate "Moore's modern "architecture."

Several modes of carrying out this invention are described, the leading feature of the invention being the introduction, in the building of arches and other structures, of bricks or stones or blocks of other hard material placed vertically, while the rest of the bricks, stones, or blocks of other material are laid in horizontal courses, or nearly so.

In the first arrangement described there are placed inside a wall or structure ranges of vertical bricks or blocks at a distance of two feet asunder. The first of these commences in the first course, at the bottom of the structure, the next commencing with the second course, and the third commencing with the third course; the next in order, again, commencing with the first course, and so on in rotation. Each of these vertical courses consists of two ranges of bricks or blocks, but the second range is commenced somewhat higher than the first, so that the two courses may "break joint."

In another arrangement single ranges of vertical bricks or blocks are placed so as to assume a zig-zag form, instead of being vertical, these ranges being parallel with each other, and three feet asunder. In building a wall "up a hill," however, these vertical bricks "continue pointing in one direction up the hill," instead of assuming the zig-zag form.

In a third arrangement double ranges of bricks or blocks are placed vertically in a manner resembling the first arrangement, with the exception that in this case the vertical ranges are not continuous, one horizontal brick or block being interposed between each two of the bricks or blocks forming the vertical ranges.

These arrangements may be varied, as also "the figure or "inclination of the vertical bricks," single columns of the latter being used in some cases, while in others the vertical bricks or blocks may be placed "apart from each other." From the drawing annexed to the Specification it would seem that some of the vertical bricks or blocks are meant to be longer than others.

[Printed, *6d.* Drawing. See Repertory of Arts, vol. 21 (*second series*) p. 325; and Rolls Chapel Reports, 8th Report, p. 89.]

A.D. 1812, March 5.—N° 3544.

BENTHAM, Samuel.—" A new mode of excluding the water " of the sea, of rivers, or of lakes, temporally, during the execution of under-water works of masonry or other materials, or " permanently for the security of foundations, applicable, for " example, to the construction of sea walls, wharfs, piers, docks, " and bridges."

For the erection of a circular pillar or column which may serve as a support for a bridge a circular dam is formed of long staves of wood, which are thicker at the lower than at the upper ends, and united together by internal rims of cast iron, the dam, however, being made in two parts, which may be united by screws or otherwise, and an iron ring being provided, into a groove in in which the lower ends of the staves are inserted, this ring having a sharp lower edge, by means of which it readily penetrates the ground below water when the dam is placed in position and weights laid thereon. When the water has been pumped out of the dam, and the pillar or column has been so far erected that the dam is no longer required, the two parts of the dam may be separated and removed, leaving the lower ring in the ground; or the whole may be raised together by suitable mechanical means.

These arrangements may be modified. For example, when it is desired to erect a pier for a bridge of which the piers shall be of oblong section the dam is of oblong form, with straight sides and ends, and in order to enable the sides and ends to sustain the pressure of the water, certain "shores" are passed diagonally from the sides to the ends, as well as from side to side, these shores being of considerable length when the dam is first formed, but being replaced by shorter shores as the work proceeds, so as not to interfere with the progress of the masonry; such shorter shores resting against the faces of the latter. The sides and ends of this dam are capable of separation; or the arrangement may be such that one side only may be detached from the rest, and the dam may be adapted for the erection of a pier or wall which shall extend into water for a considerable distance from the shore by either omitting altogether one end of the dam, or providing it with a "vacancy" which may receive a portion of wall already erected, the dam being in either case made to fit each portion of wall so as to be water-tight; and the dam may be otherwise variously adapted to the construction of wharfs, embankments, and other structures.

The dams may be either single, or composed of one line of staves only; or they may be double, consisting in this case of two lines of staves united by suitable cross bars and braces, and closed at the bottom, sharp-edged plates being placed below the latter, and a pump being arranged inside the dam, by which water may be drawn from between these plates when the dam is sinking, and may afterwards be again forced under the bottom in order to aid in raising the dam; iron framing being also described as being applicable for the connection of the woodwork of the dam to the ironwork which is sunk into the ground, certain T bolts being used, which serve as a means of connecting or disconnecting the two. The spaces between the two sides of the double dams may serve for the reception of machinery, or as lodgings for workmen; or the bottoms of such dams may be omitted, and the spaces between the sides filled with any suitable material. In some cases "perpendicular stops" are fixed to the interior surfaces of the ends of the dam, so as to regulate the distance between and afford support to the sides.

[Printed, 1*s*. Drawings. See Repertory of Arts, vol. 21 (*second series*), p. 129; and Rolls Chapel Reports, 8th Report, p. 89.]

A.D. 1817, July 10.—N° 4137.

BROWN, Samuel.—An "invention or improvement in the "construction of a bridge, by the formation and uniting of its "component parts in a manner not hitherto practised."

This invention "consists of a bridge or bridges of suspension, "in the construction of which, instead of using metal chains "formed of links, wires, or by other methods, as heretofore "practised," the patentee uses "a combination of straight bars, "bolts, or rods, joined or united at their ends either by side "plates or bolts, coupling boxes, welding, or other suitable "methods, so that these bars, bolts, or rods so joined become in "effect one entire length or piece the whole extent or length of "the bridge, and support their proper proportion of the tension "in the direct line of the curve which they assume or partake of," these constituting the "main lines or means of suspension. The "number and consistency of these main suspending lines must "depend on the extent of the span or opening and the general "magnitude of the design of the bridge, and each of the main "suspending lines may be formed of a single series of bars, bolts, "or rods joined in the manner and direction before-mentioned, or "they may consist of a lateral combination of several entire "lengths of bars, bolts, or rods, bound securely together by hoops "or other suitable means."

The invention is described at considerable length, mention being made of certain experiments conducted for the purpose of ascertaining the best form of suspension bridge. The details of the invention will not easily be understood without the aid of the drawing annexed to the Specification, but the main feature of the invention is the use of rigid bars, jointed to iron plates, a series of these bars and plates answering in place of a chain. A bridge is described in which eight series of these bars and plates (the bars being here doubled) are thrown across a river, being supported at each end by piers of considerable height, and forming a "Catenarian curve" between the piers, there being suspended from the plates which connect these bars a number of perpendicular bars, which sustain another and lower series of bars which carry the roadway of the bridge. The upper series of bars are so placed that four of the series are higher than the other four, and consequently the perpendicular bars proceeding from the plates connecting the former are longer than those proceeding from the plates joining the latter, this arrangement giving greater steadiness to the structure than would be the case if all the eight series were parallel. The bars supporting the roadway are not in a horizontal line, but form "an easy curve upwards," this arrangement tending *to prevent* undulation during storms of wind. The different series of bars formimg the upper supports of the bridge pass beyond the pier through curved trunks, and thence into excavations, where they are secured by bolts and plates.

The details of the invention may be very variously modified. In some cases a single series of bars and plates may form the " Catenarian curve," and instead of the several series forming the upper part of the bridge being placed at different altitudes they may all be at the same height, while in other cases the " Catena- " rian bars " may be formed by " the lateral combination of many " small bars." The modes of connecting the bars together may also be greatly varied. The vertical bars have " double key heads," by which they are suspended from the plates or couplings joining the upper bars, and sustain the lower bars by similar heads passing under the plates or couplings uniting them. The roadway of the bridge is constructed of planks of wood, resting upon beams, or upon other planks placed on edge, and supported by the lower bars of the bridge, these timbers being secured in their places by suitable means.

[Printed, 1*s*. Drawing.]

A.D. 1817, August 26.—N° 4163.

McCARTHY, John James Alexander.—" A road or way for " passage across rivers, creeks, and waters, and from shore to " shore thereof, without stoppage or impediment to the constant " navigation thereof, and across ravines, fissures, cliffs, and " chasms, and of a new method or methods of constructing arches " or apertures for the running and flowing of water through the " same or under bridges, to be used and applied in the con- " struction of the before-mentioned road or way and otherwise."

This invention consists of " a passage suspended in a river or in " other water, and to rise and sink therein, so that such passage " shall remain at a distance from the surface of the water sufficient " to allow a ship or ships, or other vessels, to pass over and above " the said passage; and in order that the said passage may be " buoyant, the ends of the same are formed so as to make an in- " clined plane from such parts of the passage over which ships " and vessels may pass, and so as the exits or entrances of such " passage project above the surface of the water. The said in- " clined planes continue the said passage, and connect the same " with a floating bridge made in the usual manner, the whole to " be moved both above and below. The said passage may be "formed in the shape of a cylinder, or any other more convenient "for the purpose, bent at each end to form the inclined planes, "and may be made of iron or other materials. The said passage "is gravelled, or may be paved as other roads. Care must be "taken to make the passage of such weight and substance as "that it will sink under the surface of the water to the required "depth, and that the inclination of the plane be such as to allow "carriages to pass up and down the same with safety and facility. "The ends of the inclined planes are to be sufficiently defended "against injury from ships or vessels or other external causes. "The said passage must be placed in such part of the water and "must be so connected with the said floating bridge as will be "be most suitable for the navigation. The parts of the bridge "leading from the two shores to the said passage are formed in "the usual way."

[Printed, 6*d.* Drawing. See Repertory of Arts, vol. 33 (*second series*), p. 199.]

A.D. 1822, January 29.—N° 4643.

EWART, PETER.—"A new method of making coffer dams."

According to this invention piles are used which each consist of an oblong flat plate, pointed at the lower end, and having on each side a ledge or rib of dovetailed section, these piles, when driven into the position they are to occupy, being secured together by vertical cramps, equal in length to the piles, and so formed as to pass down upon and embrace the dovetail ribs or projections on the adjoining edges of each two piles. If necessary both piles and cramps may be strengthened by "stiffening ribs." When one range of piles has been placed in position and secured by cramps a second range may, if desirable, be placed upon that, the lower ends of these upper piles not being pointed, but being furnished with two projections which enter into corresponding cavities in the upper ends of the lower piles, short dovetailed projections with cramps and wedges being also arranged so as to bind the two ranges of piles together at the joints, in addition to the long cramps which secure them at the edges, the long cramps being so arranged that the joinings of the upper and lower portions do not come in line with the joinings of the piles, and the joinings of both being rendered watertight by the introduction therein of pieces of woollen cloth or other suitable substance which has been soaked in a mixture of pitch and tar or other composition. The short cramps which secure the piles at their joinings are formed with projections or teeth, which enter into corresponding recesses in the dovetailed projections, by which means they are prevented from leaving their places, and the long cramps may or may not be secured together by a similar arrangement of projections, short cramps, and wedges. In situations where the ground into which the piles are to be driven is soft, their lower ends may, instead of being pointed, be "straight or "chisel-shaped," and near the lower end of each pile are cast or rivetted guide pieces, which when a number of piles are placed side by side have the effect of keeping all in their proper places.

In constructing a coffer dam for the pier of a bridge several frames of timber, of shape corresponding with that of the dam to be formed, are placed one upon another and braced together, the whole being then sunk into the water and secured in position by wooden piles driven inside. When the ends of this framing are of pointed form "angle or nose piles" are first driven outside such ends, and then the rest of the piles placed in succession around the rest of such framing, the long cramps being also placed in position, and the piles then driven downwards by causing a ram to act upon the heads of the piles in succession, such heads being protected from injury by the blows of the ram by a head or cap of wood, which is placed on each pile during the action of the ram thereon. In case of an obstacle which prevents the driving of a portion of the piles, one pile on each side of such obstacle is withdrawn, and replaced by another having a rib with a dovetailed projection down the front, and then a circuit of piles, passing round the obstacle, is formed in connection with these ribbed piles. The piles forming this circuit may be retained in due position while being driven by means of a hoop made in segments, and secured at the bottom of the water by bolts and temporary piles.

At the lower ends of the long cramps are projections for the purpose of filling up the cavities between the dovetailed ribs of the piles, and preventing sand or other matter from entering therein while the piles are being driven, such cavities being afterwards filled up with oakum or other substance, or cement.

Several modifications of the details of the invention are described. In some cases the projection on one edge of each pile is so formed as to embrace the dovetailed rib on the edge of the next. When the ground is such as to be easily penetrated wrought-iron piles may be used, connected by vertical cramps, but united at the horizontal joints in any manner in which such piles or plates are usually connected. When a number of piles are placed in a line of considerable length such a line may be strengthened by the introduction, at certain distances asunder, of piles which are curved outwards in front. Openings furnished with slides or valves may be formed in the piles for the purpose of admitting or excluding water, and the coffer dam may be strengthened, if desirable, by banks of earth or clay. When the joints of the piles have been firmly united by rust, a bar with a steel point may be used to loosen such joints, previous to the piles being raised.

[Printed, 10*d.* Drawing. See Repertory of Arts, vol. 43 (*second series*), p. 193; London Journal (*Newton's*), vol. 3, p. 233; Artizan, vol. 1, p. 47; and Rolls Chapel Reports, 7th Report, p. 123.]

A.D. 1822, July 4.—Nº 4688.

SMART, GEORGE. — "An improvement in the manufacture "of chains," which the patentee denominates "mathematical "chains."

These chains are for the purpose of being used in the construction of bridges. "The chains are composed of bars and bolts, "forming a combination of angles supporting one another, that "cannot be much altered from a straight line by any weight such "as bridges are exposed to sustain." These chains, "having no "thrust on their abutments, require no counteracting force to "balance their weights and the loads that pass over them." Such chains "may be carried over a great span without inter-"mediate piers, and are strong, portable, and simple in execution."

These "chains" consist in reality of a number of rigid bars, some placed horizontally, others vertically, and others diagonally, the whole being secured together by bolts, and sustaining a suitable flooring or roadway. The bars may be of wood, or of metal, or of both.

The patentee suggests the application of a structure of this character to "pendant bridges," for the purpose of preventing undulation and relieving the piers from vibration. Such structures may also be used in wharfs, harbours, and piers.

[Printed, 6*d.* Drawing. See London Journal (*Newton's*), vol. 5, p. 233; and Register of Arts and Sciences, vol. 1, p. 367, and vol. 2, p. 49.]

A.D. 1822, September 27.—Nº 4710.

FROST, JAMES.—"A new method of casting or constructing "foundations, piers, walls, ceilings, arches, columns, pilasters, "*mouldings*, and other enrichments to buildings."

This invention consists in casting foundations, piers, walls, ceilings, arches, columns, pilasters, mouldings, and other "parts "of buildings or structures" so that the same may be finished at once, and "in their places as the work proceeds." This is effected by the use of moulds, which are fixed by means of supports and braces in the situation of the structure required, "so as "to bound exactly the surface or the part of the surface of the "intended work." The complete structure may then be formed by using a quickly setting calcareous cement, having "hard and "durable" substances embedded therein, as, for example, Roman cement mixed with bricks, tiles, stones, gravel, or shingle. For aquatic purposes or damp situations such cements or compositions are selected as will readily harden under water, and for external works, such as will bear the vicissitudes of the weather.

In constructing piers, as well as foundations or walls under water, a proper cement is mixed with hard substances, such as mentioned above, and lowered into the water in boxes or bags, from whence it is then discharged; or it may be passed down through tubes supported by a temporary frame or platform, the tubes being moved into different positions as necessary, the material hardening as the work proceeds, and one layer or body thereof being deposited upon another until the pier or other structure is raised to the surface. Or the material may be lowered in bags and allowed to remain therein, one range of such bags being laid upon another, and the contents of these bags, when solidified, forming "rough courses of a well-imbedded conglomerate rock." In the latter case "slower setting cements" may in some situations be used, such as tarras or pozzolano mortar. In order to give a smooth face to the pier or other structure under water, a framework or mould may be used, which may be supported by piles until the work is complete.

In cases where the invention is not applied to the formation of a complete structure, but only to the production of mouldings or enrichments to buildings erected in the ordinary manner, the moulds are arranged and placed according to the nature of the work to be executed. Thus ceilings, whether arched or otherwise, are divided into compartments by iron ribs, these being furnished at the lower parts with "small rims or mouldings" to receive and support such compartments, and the moulds must be surcased inside before use with some substance which will prevent adhesion thereto of the materials employed for the work, the moulds being of course removed as the materials harden. For producing cornices and ceilings with a fine face, the moulds are first lined with plaster of Paris mixed with water to a "creamy consistency," a coating of plaster or cement being then laid inside that, and the rest of the mould quickly filled up with cement mixed with hard materials as mentioned above, or with bricks, tiles, or squared stones laid in regular courses, the surfaces being afterwards smoothed and dressed as requisite.

[Printed, 4*d.* No Drawings. See Repertory of Arts, vol. 44 (*second series*) p. 133; London Journal (*Newton's*), vol. 5, p. 66; and Engineers' and Mechanics' Encyclopædia, vol. 1, p. 526.]

A.D. 1822, November 9.—N° 4723.

MOXON, JOHN DOWELL.—" Improvements in the construction " of bridges, and works of a similar nature."

The first part of this invention consists of a moveable coffer dam, composed of inner and outer timbers "to open at each end " and without bottom, with internal or external piles, or both at " option, to drive after the framework has grounded upon the " bottom or bed of the river," this machine being capable of removal without being taken to pieces. This coffer dam "is " made at bottom in form of a wedge, so as to cause it to enter " or cut into the bed or bottom of the river," the piles being then driven to render the whole stationary. The dam is then rendered watertight by pouring clay, &c., into a space left between the internal and external timbers for the purpose.

Another part of the invention consists in coating or facing the piers of stone bridges with iron, for the purpose of strengthening and preserving such piers. An arrangement is described in which the outer stones of the pier are each surrounded with iron, the latter being six inches thick on that portion of the stone which is to form part of the face of the pier, and three-quarters of an inch thick round the remaining portions, these coated stones being connected by clamps. To prevent "lodgements of water at the " external surface" holes are formed in the outer metal of one course of stones, into which short spikes or studs project from the next. This part of the invention may also be applied in fortifications, wharfs, &c.

Another part of the invention consists in the construction of bridges by the employment of boxes or troughs of metal, which are put together much in the same manner as the stones of a bridge formed of masonry, certain of these boxes being used to build the arches, and the spaces between the arches being occupied by other boxes, the whole being bound together by ribs or beads in the boxes between the arches, which fit into grooves in the edges of the boxes forming such arches. The outer sides of the boxes forming the external parts of the arches are "cast to " resemble cut stone." The "iron flooring for supporting the " roadway is not at top, but forms the boundary of the under " part of the arch, and has thus the appearance of stonework. " Thus when the road is filled up and falls down into the spaces " between the ribbs and boxes of the arch, &c. &c. there will be " no tremulous motion, nor the noise peculiar to iron bridges " when heavy carriages are passing over them." From certain of the figures in the drawings annexed to the Specification it would seem that in some cases all the boxes used are to be furnished with both ribs and grooves, the ribs of one entering the grooves of another throughout the structure, and a footpath on each side of the bridge is described as being "erected on three or four of " these ribs crossways by thin plates of cast iron which have " grooves to receive the said ribs, and on these plates the stones " are to be placed, unless iron is preferred, which can be roughed " and rendered neat, safe, and as clean as stone."

"In extending this system to lighthouses, casts of the proposed ' situations can be taken, when of rock, in its natural form without much dressing or levelling, which will make the work " stronger; and in foundations of softer matter, iron joined in " one entire mass will form a good foundation for any superstructure," "and the foundation or bottom plates can be " placed and affixed to the usual precaution of piles either of " iron or wood."

If desirable, the piers of bridges, as well as the upper parts of such structures, may be formed of boxes or troughs such as mentioned above. The whole structure is united, on this system, " into a compact body without screw or cement."

The same system is applicable for wharfs and other erections.

[Printed, 2*s*. Drawings. See London Journal (*Newton's*), vol. 8, p. 123; and Rolls Chapel Reports, 7th Report, p. 124.]

A.D. 1823, April 16.—N° 4777.

GRAULHIE, Gerard.—(*A communication.*)—"A machine or " apparatus upon a new and portable construction, capable of

" being inclined in different degrees, adapted to the conveyance " of persons and goods over water or ravines for military or " other objects, and applicable also to purposes of recreation and " exercise."

According to this invention chains or ropes, which may be tightened at pleasure by windlasses, are supported by upright posts of different elevations, there being laid upon these ropes or chains "tables" of wood, metal, or other substance, these tables forming a flooring along which passengers or merchandise may be conveyed across a river or other place. The tables are connected together by ropes or chains, passing through holes on each side of the tables, one edge of each table being concave while the other is convex, so that when a number of tables are laid together the convex entering the concave parts form a series of joints. Some of these tables are of square form, and others curved, the latter being employed in cases where it is desirable to form a curved bridge or track. The tables are furnished with "ways," or rails, which will not only direct the wheels of cars running upon them, but serve to connect the boards of which they are formed, tenons or rabbets preventing any side motion of the tables. A balustrade of ropes and network is passed along each side of the structure, such ropes and network being connected to the posts above and the tables below.

Structures of this kind may be variously modified according to the situations in which they are to be used. Thus a single range of tables, suitably supported, may form a single bridge, while on the other hand a double range of tables, forming a double bridge, may be used, the ends being connected in a semicircular form by the use of curved tables at those parts, and this arrangement affording the means of either keeping the cars in continuous motion or otherwise. The cars have their axles so arranged that the wheels accommodate themselves to the curved ways, and the bodies of the cars are so mounted in connection with a hooked lever that such bodies may be retained in a horizontal position, although the wheels may rest upon an inclined plane. In order to draw the cars up such an inclined plane, where it is necessary that a portion of the bridge should be in that position, an "endless rope or chain ladder" is passed round wheels or drums, one of which is at the top and the other at the bottom of the incline, the upper drum or wheel having on its axis a winch by which motion may be given to the "ladder," the bars of which, acting against the hooked levers with which the carriages are furnished, raise the latter along the incline as required. The cars will then run down the other inclined parts of the structure by their own gravity. The semicircular parts of the structure are somewhat lower at the inner than at the outer ends of the tables, this arrangement preventing the cars, when passing round these parts, being thrown from the track by the action of their own centrifugal force. The cars are further secured from leaving the rails by rods or wires so connected to the posts as to project over the ends of the axletrees outside the wheels, these rods or wires thus preventing the cars from "rising and running over the ways."

It is not stated how this invention is to be applied to "purposes "of recreation and exercise," but it is probably meant that such recreation and exercise may be obtained by persons seating themselves in the cars and travelling to and fro along the apparatus.

[Printed, 8*d*. Drawings. See London Journal (*Newton's*), vol. 7, p. 180.]

A.D. 1826, March 4.—N° 5342.

MIDGLEY, ROBERT.—"A method, machinery, or apparatus for "conveying persons and goods over or across rivers or other "waters, and over valleys or other places."

The patentee says,—"My invention consists in a moveable plat"form or car supposted upon legs or pillars braced in diagonal "directions to keep them in proper positions, and having wheels "and axles at the lower ends to roll on a double railway crossing "a valley or the bed of a river, drawn by a rope or chain attached "to the car (so as not to obstruct the passage of craft on the "river), and to windlass or capstan fixed on the banks of rivers, "or at other suitable positions, worked by animal or elementary "power. In some cases I apply the moving power on the plat"form or car, communicated by axles and wheels or other suitable "appendages to a pinion taking into a rack crossing the valley or "river, and parallel to or else forming a part of the railway. The "platform or car should be a corresponding height with piers or "landing places made on each side of the valley or river above "high water, between which the car is to pass and repass with "foot passengers, animals, carriages, or goods, as required. Small "plows are fixed to the poles or legs to keep the railway clear of "obstacles. Drags are suspended at each end of the car, move"able on pivots, to draw mud or sand that collect near the rail-

" way at the sides of the river to the middle, where, by turning on " the pivots, and moved by power on the platform, it leaves the " mud or sand. The car may be made of metal, or a combination of metal and wood. Its dimensions will depend on the " depth of the valley or river to be crossed, and the bulk of that " which is to be conveyed. The platform to be fenced on each " side. A moveable fence to be placed at each end to prevent " passengers from falling off."

[Printed, 4*d*. No Drawings. See Repertory of Arts, vol. 4 (*third series*), p. 58; London Journal (*Newton's*), vol. 14, p. 27; Register of Arts and Sciences, vol. 1 (*new series*), p. 150; and Engineers and Mechanics' Encyclopædia, vol. 2, p. 478.]

A.D. 1831, October 31.—N° 6187.

MACDONALD, James.—(*A communication.*)—" A certain improvement or improvements in the construction of bridges " made of iron or other materials; which improvement or improvements are also applicable to the construction of piers, " railroads, roofs, and other useful purposes."

[No Specification enrolled.]

A.D. 1833, January 24.—N° 6369.

MACDONALD, James.—(*A communication.*)—" An improvement or improvements in the construction of bridges made of " iron or other materials, which invention is also applicable to " other useful purposes."

This invention is " founded upon the same principles as those " set out" in the Specification of a patent granted to the present patentee on the 29th of June, 1832, and relating to an improved construction of railway.

According to the present invention bridges or arches are constructed " by combining series of iron bars or ribs so arranged " and connected as to sustain or support the pressure and tension " of each other, the whole, when combined, constituting an expanse of framework in the form of the segment of a polygon or " arch, upon the upper surface of which framework the floor of " the bridge or carriage way, or covering of a roof, is to be laid. " The principle on which the tension and support of the framework is founded may be illustrated by reference to the principle of construction in the rafters, tie beam, and ring post of " roofs, the structure of the bridge consisting of combined rafters, " with tie beams and ring posts intersecting each other, and con-

"nected in parallel ranges by transverse bolts and diagonal "braces for the purpose of firmly securing the whole structure."

Different modifications of the invention are described, reference being also made to certain portions of the Specification of the patent mentioned above.

The essential features of the invention are the combining together a number of bars, some in a horizontal and others in a diagonal position, while others are vertical, or nearly so, and uniting the whole by bolts and nuts, two structures of this kind being placed parallel with each other and being united together by transverse bolts and braces, and a number of these double structures again being placed side by side and united in the same way to form the framework of the bridge, upon which pillars or spandrils are placed to support a level roadway, the bars composing the ribs of the framework being somewhat longer than those at the lower part, which gives the framework a curved or arched form.

The patentee mentions that bridges with "very flat arches" may be constructed on this system, and that the ends of the framework described above may rest upon piers so constructed as to "merely sustain the downward pressure." He adds, however, that he proposes to raise abutments upon the piers, and to cause the ends of the upper bars or ribs to rest against such abutments, there being a small space left between the abutment and the lower bars or ribs in order to allow of the latter extending in case of a slight deflection of the bridge on a load passing over it, and also to admit of expansion and contraction of the metal under variations of temperature.

Arches constructed on this system may be used "to form the "framework for roofs of buildings with good effect," as also for the support of aqueducts.

[Printed, 1*s*. 4*d*. Drawings. See London Journal (*Newton's*), vol. 3 (*conjoined series*), p. 181; and Rolls Chapel Reports, 7th Report, p. 142.]

A.D. 1833, June 20.—N° 6438.

GIBBS, Joseph, and **APPLEGARTH**, Augustus.—"Certain "improvements in the construction of railroads, bridges, piers, "jetties, and aqueducts, part of which may be applied to other "useful purposes."

In forming a structure, according to one part of this invention, certain foundation plates are firmly secured to the ground by means of bolts, which are each furnished at the lower end with short arms or flukes, so jointed thereto that when the bolt is being thrust into the earth they assume a vertical position, passing into the ground freely, but on the bolts being again drawn slightly upwards, which is done by means of nuts on their upper ends, the arms or flukes diverge, and the apparatus then acts as an anchor, retaining the foundation plate in position. Upon plates thus secured upright columns are then mounted, suitable framing being secured upon these so as to form a railway or other bridge or viaduct, or a trough for the reception of water being placed thereon, and an aqueduct thus constructed. If desirable, the bolts, while being passed into the ground, may be surrounded by tubes, which may afterwards either be withdrawn, or remain and be filled with cement. In the case of a railway bridge the rails are furnished at the ends with "dove-tail hooks" which enter into connecting links placed on the framing and are secured in their places by wedge pins and keys, the spaces between the rails being wholly or partially closed by woodwork. A mode of constructing a railway is also described in which the rails are secured to chains, and the latter fastened to the ground by bolts and flukes. A method of tightening rails is also described as consisting in the use of a "staple link" with screwed ends and nuts, and a certain connecting piece, and various modes of arranging and coupling rails are set forth. In some cases an "under or "supporting rail" of cast-iron has mounted upon it a wrought-iron rod, for the purpose of diminishing the number of joints and also of connecting the rails more firmly together, the ends of the lower rails resting in chairs of convenient construction, and the rail rods being bent down at the ends and wedged into sockets formed in the lower rails; or the rods may be placed in recesses in the lower sides of the other rails. A chain is described as being for the purpose of receiving the ends of these compound rails, the ends of the rails being wedge-shaped, and the interior of the chain corresponding therewith, wedge-shaped keys binding the ends of the rails in the chairs. When these rail rods are on the top of the ordinary rails the wheels of the vehicles which travel upon them may either be of the ordinary character or have concave rims, the rods being circular in section.

A mode of constructing bridges, piers, or similar structures is described, in which columns are supported by foundation plates and anchor bolts sunk under water and into the ground below it, each bolt being in this case surrounded by a caisson or vessel filled with concrete or other suitable substance. The caisson and bolts are driven down together by a pile-driving machine of the ordinary character, mounted in a boat having a well therein for the descent of the caisson, and the bridge or other structure may have a flooring of planks laid upon rods, or stones or planks may sustain the materials of an ordinary road.

[Printed, 2*s*. 2*d*. Drawings. See London Journal (*Newton's*), vol. 14 (*conjoined series*), p. 399.]

A.D. 1835, December 3.—N° 6942.

WITTY, Richard.—" An improved method or methods of " arranging and combining certain materials used in constructing " houses, bridges, and other buildings, whereby greater strength " and durability will be obtained."

Before describing this invention the patentee refers to the well-known fact that a number of thin plates or laminæ of wood or metal, placed side by side, will bear a greater load than the same quantity of wood or metal in the form of a solid beam or bar, and also to the circumstance that, on account of the great tendency of such thin plates of wood or metal to deflect laterally, but little advantage has been taken of their capacity for bearing weight. The first part of the invention relates to a mode of so combining plates or laminæ as to counteract the tendency to lateral deflection. The plates may consist wholly of either wood or metal, but preferably of wood and iron combined, the iron plates being of rolled metal, and there being between each two iron plates one of oak or some other wood, these wooden plates being at least twice as thick as those of metal. These are then all pinned or bolted securely together, " so as to form them into one compound beam or bar." The two outer plates are of metal, and thicker than the rest, so that they may the better sustain the pressure of the pins or bolts, and resist the lateral deflecting tendency of the plates. When the beam or bar is required to be of greater length than the individual plates of which it is composed, plates of the same or of different lengths are so arranged that not any two ends of the plates shall coincide, the fastening pins or bolts being inserted at the different points of junction.

The second part of the invention is subsidiary to the first, and consists in girding, trussing, or supporting laminated beams or rods compounded as aforesaid, by the employment of "regularly "formed iron segments of circles or segmental hoops," secured to the beams at the ends. "The beam forms the chord line to "the segment of the circle or segmental hoop or girder. The "versed sine may be of any depth," but the patentee prefers "that "the segments should be arcs of large circles with versed sines of "not less than one inch for every three feet of the length of the "beam or chord line." The segments are secured to the beams by bolts, blocks, or stays of hard wood or cast iron being inserted "at regular intervals in the space between the chord line and iron "segment," these blocks or stays being pressed upwards against the beam by means of the bolts, and the whole so bound firmly together.

A bridge is described as being constructed of a laminated beam, which forms the balustrade, with an ornamental railing at the top, and a "segmental hoop" secured to the lower side of the beam.

Other arrangements of the same character are described as being applied in the construction of roofs, floors, and railways, in the latter the laminated beams alone being used where the railway passes along a solid embankment, but being strengthened by segmental hoops or ties where it is necessary to form them into a bridge.

[Printed, 6*d*. Drawing. See Mechanics' Magazine, vol. 26, p. 38.]

A.D. 1836, June 17.—N° 7120.

DREDGE, James.—"Certain improvements in the construction "of suspension chains for bridges, viaducts, aqueducts, and other "purposes, and in the construction of such bridges, viaducts, or "aqueducts."

These improvements "have for their objects, first, a means of "affording greater strength and stability than has been obtained "by any of the varied constructions of suspension bridges, piers, "or other erections of that kind, which have been heretofore con-"structed of corresponding magnitude and extent; and, secondly, "the economy of materials and labour required to be expended "in such erections."

The invention consists, firstly, in "so arranging and connecting "a series of parallel links to constitute the chains, that the chain "may diminish in breadth, and consequently in weight, as it "*recedes from* the point or points of suspension." These links are connected by transverse bolts, the number of links in each series diminishing as they recede from the piers towards the centre of the bridge.

Secondly, "in applying such chains to the purposes of constructing suspension bridges and other similar erections in connection with inclined suspension bars or rods (instead of the usual perpendicular suspension bars or rods)," by which means the longitudinal bearings of the horizontal platform or roadway are so connected to the hanging chains "that the weight or principal leverage of the erection may be removed from the centre and be sustained by the stronger parts of the chains, increasing towards the abutments."

Thirdly, the invention relates to the employment of transverse tie-beams of a peculiar construction, for confining the longitudinal bearings of the horizontal platform or roadway. These tie-beams are "bowed upward," and retained in that form by string or tension rods.

Fourthly, the invention consists in "the adoption of a ball-and-socket bearing to the inclined suspension bars or rods, by means of which the level or proper position of the platform may be readily adjusted." The suspension bars pass through saddle pieces connected to the transverse tie-beams, a ball at the lower end of each rod bearing against a recess or socket in the under side of a saddle piece, each rod being furnished below the ball with a "screw nut" for the purpose of adjustment.

[Printed, 1*s.* 2*d.* Drawing. See London Journal (*Newton's*), vol. 11 (*conjoined series*), p. 1; Mechanics' Magazine, vol. 28, p. 422, and vol. 38, pp. 213, 234, 365; Engineers and Architects' Journal, vol. 3, pp. 193, 236, and vol. 4. p. 251; Artizan, vol. 4, p. 249; and Rolls Chapel Reports, 7th Report, p. 176.]

A.D. 1838, June 18.—N° 7692.

WHITE, JOHN.—"Certain improvements in the construction of railroads, bridges, and viaducts."

This invention consists "in adding strength to such metal rails and bars as may be used for railways, and also to such timber beams, supporters, and bearers as may be used in the construction of bridges and viaducts, by giving tenseness to the same by means of keys or lateral wedges."

In carrying the invention into effect, "resistance piles" are used, which consist of piles firmly fixed into the ground, capped with lead, and carrying blocks of iron, having horizontal mortices therein, through which wedge-formed keys are passed, these keys also passing through openings in the beams, rails, or bars to be operated upon, the end portions of which rest in recesses in the blocks, the whole arrangement being such that on driving the keys more or less through the openings in the blocks and in the beams, rails, or bars, the latter are drawn into a state of more or less tension, as may be desired.

In the case of a railway, "resistance piles" may be placed at the distance of about one-sixteenth of a mile from each other, there being at intervals of about fifteen feet between them common piles carrying blocks of smaller size, "and fastened down " by spikes passing through holes sufficiently larger than the " spike to admit of the play consequent on expansion and con- " traction," arising from changes of temperature.

[Printed, 10*d*. Drawing. See Engineers and Architects' Journal, vol. 1, p. 374.]

A.D. 1838, September 20.—N° 7814.

DAY, William.—" An improved mode or method of applying " and combining timber and other materials used in the con- " struction of ships or vessels, masts, yards, beams, piers, bridges, " and various other purposes."

[No Specification enrolled.]

A.D. 1838, November 3.—N° 7845.

FRASER, Joseph.—" Certain improvements in the apparatus or " machinery to the employed as centerings or supporters in the " construction of bridges and arches, and in tunnels or other " mining operations."

The Specification of this invention is of very considerable length, but the "characteristic" of the apparatus employed, "whereby it " is distinguished from the centerings or supporters heretofore " used," is set forth as being "first, that the foremost or most " advanced of the centres or supporters which is to bear the fore- " most ends of the laggings whereon the bridge, arch, or tunnel " is to be constructed or built is not as heretofore an interior " centering to the intended arch, but the said foremost or most " advanced center or support stands at the end of the arch that is " to be constructed or built, the chief part of its substance being " in the space which will be afterwards occupied by the brickwork " or masonry of a future length of the arch, and standing oppo-

" site to the place of the toothing which is to be left at the end of
" the arch for joining with that future length; the said foremost
" or most advanced centre or support sustaining the foremost
" ends of the laggings, by a suitable connexion of these ends with
" its interior or concave edge, and the two ends or feet of the said
" foremost centre or support standing with suitable sole plates,
" blocks, and means of adjustment, upon advanced portions of
" the two side walls from which the arch is to spring, and the
" hindmost vertical face of the said foremost or most advanced
" centre or support having a suitable pattern for the intended
" courses of brickwork or masonry formed in relief upon it, or
" marked upon it, to serve as guides for the laying of such
" courses."

" Secondly, the addition of a slight temporary centre to sustain
" the hindmost end of the laggings quite independently of the
" main centres, for the support of the laggings whilst the arch is
" building, and before it is closed or keyed in at the top or
" crown, and which slight temporary centre is set up with its two
" feet or ends standing (with suitable means of adjustment) upon
" supports fixed into the side walls, and projecting out therefrom,
" or on the ends of props reared up against those side walls."

" Thirdly, that the other centres or supporters, which are to
" bear the hindmost ends and the mid-length of the laggings
" whilst the arch is building on them, are erected and supported
" on a moveable frame or platform, which is let down to rest on
" trucks or wheels (after the arch is closed or keyed in, and the
" said centres are lowered so much by such letting down as to
" quit contact with the laggings (leaving the same undisturbed
" and supported by the foremost or most advanced centre, and
" by the slight temporary centre), whilst the said frame or plat-
" form, with the hindmost and middle centres, is moved or
" advanced forwards on its trucks or wheels, in order to carry the
" middlemost centre or centres beneath the foremost or most
" advanced centre. And note:—If the latter is made with cross
" bars or internal framing, either those bars or framing must be
" removed," " or the said middlemost centre or centres must be
" taken to pieces or laid down flatways on the said moveable
" frame or platform," " in order that it or they may be so carried
" beneath the said foremost centre as aforesaid; and the said
" moving or advancing forward of the frame or platform being
" continued until it has carried the hindmost centre close up to

" the front or most advanced centre, then the frame or platform " is raised up so much as to take it off its trucks or wheels, and " as to carry up the hindmost centre in contact with the fore- " most ends of the laggings, and that contact is made complete " with all the several laggings," by aid of "setting screws or " of wedges, with which the hindermost centre is provided," and "after that contact has been made complete, the front or " most advanced centre may be moved or advanced forwards, " leaving the laggings undisturbed and resting on the slight " temporary centre and the hindmost centre, in order to support " the arching."

"Fourthly, that the several centerings or supporters to be used " in the construction of arching within underground tunnels are " made with metal extending all the way around the curve; and " if made in pieces of metal, the same are strongly united by " revitting or screwing metal to metal, so as to preserve a " continuity of metal throughout the curve, and each centre " consisting of one such continuous curve of metal, or of two or " more such curves combined together, and which may have " wood interposed between them or otherwise combined with " them, in order by such application of continuous metal curves " to give sufficient strength to the curved portion of the centre to " enable it to be formed like a simple bow or arch," "having all " the matter which is to give it strength disposed in its curve, " without requiring internal framing (or at most only a cross tye " or string to bow), whereby the space within such centre is left " clear for the operations of the workmen to be carried on with- " out the embarrassment and crowding that is caused by the " cumbrous internal framing of wood usually employed in cen- " trings." The patentee states that he makes no claim to this fourth article, except for the "construction of arching within " underground tunnels."

[Printed, 1s. 6d. Drawing.]

A.D. 1839, February 21.—N° 7975.

NASH, William.—(*A communication.*)—" Certain improvements " in the construction of bridges, viaducts, roofs, and other parts " of buildings."

This invention consists "in a peculiar form, arrangement, and " mode of connecting bars of iron or beams of wood placed

“ diagonally at acute angles, and braced together by other bars “ or beams placed in horizontal positions and parallel to each “ other, which combination or structure affords a degree of “ stability from its firm tension that is not found in any of the “ ordinary constructions of bridges or roofs composed of similar “ weights of material, either on the suspension or tension “ principles.”

The ends of the diagonal bars are so formed that when the bars are “placed in diagonal positions at acute angles” such ends may fit accurately into recesses or notches formed in the horizontal bars, the latter forming the top and bottom of the structure, and being connected by “socketed joints,” bolts securing the whole together. In addition to the top and bottom horizontal bars a “middle horizontal bar” is used, this being furnished with diagonal notches or recesses in which the diagonal bars are secured. All the horizontal bars are composed of two pieces of metal closely braced together, and suitably enlarged at the parts in which the notches or recesses are formed.

In constructing a bridge two of the structures described above are placed at a suitable distance asunder, the ends being connected to upright pillars which rest on piers formed to support them, and these two structures constitute the two sides of the bridge; they are then braced together by “ diagonal transverse bars,” the ends of which bear upon the middle horizontal bars, and which have also connected to them longitudinal bracing bars supporting the roadway or flooring of the bridge. A bridge of this construction does not require any abutments or ties beyond its ends, “as the “ whole pressure or weight of the erection is, by the bracing of the “ bars, concentrated in the ends bearing perpendicularly upon the “ piers.”

[Printed, 8*d*. Drawing. See Repertory of Arts, vol. 6 (*new series*), p. 145; London Journal (*Newton's*), vol. 15 (*conjoined series*), p. 355; and Inventors' Advocate, vol. 1, p. 83.]

A.D. 1839, March 12.—N° 7999. (* *)

CUTLER, JOB.—“An improved method or methods of con“ structing chains for suspension bridges, cables, mining and “ other purposes, and for an improved method of making the “ bars, links, and bolts thereof.”

According to one modification of this invention a broad chain is formed consisting of three and four links arranged alternately

These sets of links are not only connected by pins passing through the ends of each and forming the joints of the chain, but also by there being at each side of the eye or end of some of the links bosses which project into corresponding recesses formed in those to which they are jointed, the different sets of links being also united by bolts passing through them, and the effect of the whole arrangement being that even if the pins at the joints of the chain were removed or broken the chain would still hold together. This construction of chain is mentioned as being suitable for "pit "chains, cables, and suspension bridges."

The arrangement is modified in another construction of chain suitable for "driving machinery or other purposes," but which does not require special notice here.

The links of these chains are brought to the required form by the use of "dies," which the patentee describes.

[Printed, 8*d*. Drawing. See Repertory of Arts, vol. 13 (*new series*), p. 242; Inventors' Advocate, vol. 1, p. 99; Transactions of the Society of Arts, vol. 54, p. 159; Websters' Reports, vol. 1, p. 418; Carpmael's Reports on Patent Cases, vol. 2, p. 523; Myline and Craig's Reports, vol. 4, p. 510; and Billing on Patents, pp. 24, 79, and 142.]

A.D. 1840, February 22.—N° 8391.

KERR, THOMAS.—"A new or improved mortar or cement for "building, also for mouldings, castings, statuary, tiles, pottery, "imitations of soft and hard rocks, and other useful purposes, "and which mortar or cement is applicable as a manure for "promoting vegetation and destroying noxious insects."

This mortar or cement is composed of four "principal ingre-"dients." The first (which the patentee distinguishes as No. 1) consists of the rakings of roads or streets, or the sweepings of buildings, or of ashes, or small coal, culm, or breeze, or river or sea sand, or pounded stone, "or of any other mineral or vegetable "substance in a state of dust or powder." The second ingredient, or No. 2, consists of chalk or other calcareous substance of a drying and retaining nature, in a state of powder. The next ingredient, or No. 3, consists of tar, oil, resin, "or some other "substance of the like bituminous, fatty, or inflammable nature;" and the last ingredient, or No. 4, is "simply bay or common "salt."

These ingredients are mixed together in various proportions, according to the purpose for which the composition is intended. Thus, for a mortar or plaister for building purposes, four parts of

No. 1 are mixed with one part of No. 2, and the same quantity of No. 3 and No. 4. For coating flat wooden roofs two parts of No. 1 are united with the same quantity of No. 2, and one part of No. 3 and No. 4 respectively, and in this case, as also when the cement is used as a "composition flooring," the cement may be used in a warm state, and the surface smoothed by a hot iron. Such a surface may have a metallic appearance given to it by spreading filings of metal upon it before it has become hard; or the surface may be covered with powdered chalk or other material.

The composition is set forth as being applicable to a great variety of purposes, including the covering of "the weather " boarding of wooden houses," and of slate, tile, and thatched roofs, the formation of "pavements or footpaths round houses," as a cement for the paving stones of streets, and for the "im-" provement" of macadamized roads; as also for the "arches of " bridges, culverts, drains, et cetera." In these last-mentioned cases the cement "may be either employed in the way of ordinary " mortar, observing only the precaution to cover the centrings " with strong paper to prevent any adhesion of the surfaces; or " where the structure is of small span, the cement (mixed with " small stones) may be cast in moulds into blocks to be used in " place of bricks or stones, filling up the joints between these " blocks with the same cement in a hot or fluid state."

Mouldings or castings formed of this composition may have the resemblance of stone or marble given to them by portions of such stone or marble, ground into powder, being introduced into the composition; and for tiles, bricks, and pottery the composition may be mingled with brick clay, while for fire-bricks and flags not only clay but granite in a state of powder is mixed with the other ingredients. The composition is also applicable as fuel, for the construction of gas and water pipes, for the preservation of ropes, cables, and cloths of various descriptions, for rendering papers, "carding," and "boarding" waterproof, and for coating ships' boats and other sailing craft, in which case pipeclay is introduced into the composition.

The patentee mentions that when this composition is used as a manure the seeds or roots which are to be planted in the ground prepared therewith are "dipped in tar made thin with salt water," care being observed not to take up so much as to cause any "coating" of such roots or seeds.

Those parts of this invention which relate to roads and ways have been already described in the series of Abridgments relating thereto.

[Printed, 6*d*. No Drawings. See London Journal (*Newton's*), vol. 21 (*conjoined series*), p. 415; Mechanics' Magazine, vol. 33, p. 253; and Inventors' Advocate, vol. 3, p. 131.]

A.D. 1842, February 8.—N° 9247.

SLEIGH, ADDERLEY WILLCOCKS.—"A certain method or "certain methods of effecting and forming sheltered floating "harbours of safety by the employment of certain buoyant sea "barriers applicable thereto, and which said improvements are "also applicable to and useful for the formation of breakwaters, "floating bridges, lighthouses, and beacons, the protection of "pier heads, embankments, and for other similar purposes."

This invention consists "in the construction and adaptation of "sloping or oblique platforms mounted upon, connected to, or "supported by floating hollow vessels or caissons, by which the "platforms are always maintained in the sloping or oblique "positions, and are enabled to rise and fall with the tide. These "floating vessels and sloping platforms when constructed are to "be so arranged as to form sea and wind barriers for sheltering "ships and other vessels, and also pier heads, bridges, and other "structures requiring such shelter, from the ordinary destructive "effects of heavy seas and gales of wind."

The details of this invention may be greatly varied. One arrangement is described in which a caisson is constructed of peculiar shape, "being of the form of an oblong longitudinal "wedge," with the bottom flat, the back, or that part which in the case of a breakwater is meant to be next the shore, "rounded "like the side of a vessel," and the upper surface forming an incline or slope the lower part of which is next the open sea. This vessel may be made of ribs of timber planked on the outside, or of sheet iron, or other material. Through the centre of the vessel extends (longitudinally) a beam or "keel," which "will be the "centre of motion" on which the vessel floats. On the inclined upper surface of this vessel is mounted a platform, this forming a broad inclined plane the lower edge of which is immersed in the water, while the upper portion projects above and beyond the back of the vessel which sustains it, this platform sloping upwards from the sea towards the shore at an angle of about 30°, "in "imitation of the slope of a supposed beach," and affording a

" modified resistance " to the action of the waves. These structures may be moored in any suitable situation, and a number of them may be so connected together by ball and socket or links and toggle joints at the ends of their beams or keels as to constitute a harbour of refuge. Instead of a vessel or caisson constructed as above described, a floating framework supported by a number of barrels, or other hollow wooden or iron vessels, may be used to sustain the inclined platform; or a raft may be used; or the platform may be used alone, one edge being moored by chains or otherwise to the bottom of the sea, " in such a manner that the " upper edge may rise from the water in an inclined direction."

Floating bridges, lighthouses, and beacons, are to be constructed on the system described above, the invention being susceptible, however, of various modifications.

[Printed, 1*s*. 8*d*. Drawings. See London Journal (*Newton's*), vol. 24 (*conjoined series*), p. 97; Mechanics' Magazine, vol. 37, p. 213; and Record of Patent Inventions, vol. 1, p. 4.]

A.D. 1842, April 26.—N° 9332.

PALMER, Henry Robinson.—" An improvement or improve" ments in the construction of roofs and other parts of buildings, " and also for the application of corrugated plates or sheets of " metal to certain purposes for which such sheets or plates have " not heretofore been used."

The leading feature of this invention consists in the employment of corrugated sheets or plates of metal so arranged that such plates " abut on and support each other." A bridge is described in which a number of corrugated cast-iron plates are used, these plates being each so curved that when a number of them are placed end to end they form an arch, the corrugations running lengthwise of the structure. Several ranges of these plates are placed side by side so as to form a bridge of sufficient width, and each plate is surrounded by flanges through which bolts or rivets are passed, the side flanges of the plates being also bolted to ribs or spandrils passing above the plates the whole length of the bridge. The effect of this arrangement is that the strength of the bridge is not dependent upon the rivets, the plates acting upon and sustaining each other in the same manner as the stones of an arch composed of masonry, the whole resting upon or against suitable piers.

For constructing a roof the plates are, according to one arrangement, formed with slits or notches at one end and studs or projections at the other, so that when a number of plates are placed end to end the studs of one enter the slits of the next, the side edges of the plates being inserted in grooves formed in bars placed longitudinally to receive them. The notched ends of the plates are slightly "upset or cranked," so that the ends of the plates carrying the studs may pass under them, and the studs are furnished with heads which further secure the plates together. In other arrangements "hook-shaped or cleft studs" unite the end of the plates, the slits being dispensed with.

The arrangements mentioned above are more especially applicable where plates of cast metal are used. When wrought-iron plates are employed they are notched at each end, and "separable "studs" inserted into these notches, these studs having heads at each end. In this case one end of each plate may be upset or cranked as already mentioned, or the ends may be plain, and a strip of metal brazed or soldered to the upper or under side of one be rivetted to the next.

An application of corrugated sheets of metal in the construction of railway and other wheels is also described, the sheets here occupying the place of spokes or arms, and being united with suitable naves, rims, and tires.

This invention is set forth as constituting improvements on the invention for which a patent was granted to the present patentee on the 28th of April, 1829, according to which plates of corrugated metal were employed, but not with their ends abutting against each other as described above.

[Printed, 1*s.* 10*d.* Drawings. See London Journal (*Newton's*), vol. 23 (*conjoined series*), p. 77; and Record of Patent Inventions, vol. 1, p. 227.]

A.D. 1845, August 5.—N° 10,803.

MAIRE, Peter Francis.—(*A communication from Adolphe Jacquesson.*)—"Improvements in combining iron and other materials "for the purpose of constructing bridges, roofs, arches, floors, "and other similar structures."

The first part of this invention consists mainly in connecting together certain frames by means of hollow cylindrical cross bars, bolts passing through holes in the frames and through the hollow bars and so uniting the whole together. Such frames and bars, thus united, constitute what the patentee calls "a parallelopipedon "in one piece," and such parallelopipedons may be used for various purposes, a number of them, for example, placed one upon another, serving as a column; in this case long bolts being used, which pass through the whole of the frames and connecting bars used. This part of the invention is described under different modifications, the frames and cross bars being in some cases so arranged as to partake of the wedge form, and being thus suitable for the arches of bridges. In other cases the frames are connected by solid cross bars, having ears or projecting pieces at each end, which admit of two short bolts for connecting them to the frames, the solid cross bars being themselves united by longer bolts, passing through other cross bars which are hollow. An arrangement of this kind is described as constituting the arch of a bridge, two upper and two lower solid bars, of curved form, being united by bolts passing through vertical and horizontal hollow cross bars, and frames being only introduced at certain parts of the structure.

Another part of the invention consists in constructing the arches of bridges of what may be termed hollow blocks of metal with large openings in the sides and ends, and also holes in the latter for the recepion of bolts. These blocks, or "forms," may either be of rectangular figure on the outside, or may partake of the wedge form. In the latter case a number of them being placed end to end, with the smaller ends downwards, and bolted together, will form an arch without the introduction of any other object between them, but when they are of rectangular figure they are made to constitute an arch by the use of certain "braces," or by the introduction between them of keys or plates thicker at the upper than at the lower ends, and of which different modifications are described, in some cases these plates having projections at the upper and lower ends which aid in maintaining the blocks in position, while in other cases (including those in which the rectangular blocks are employed) bands or bent pieces of metal pass over the junctions of the parts and render the structure more secure. In one arrangement the wedge-shaped plates have screws projecting from each end, which serve to bind to the upper and lower surfaces of the arch continuous plates of wrought iron. A bridge is described of which the archway is composed of several series of blocks or "forms" united by cross bars, the archway carrying on its upper surface a number of "hollow shoes" in which rest rounded projections forming the lower ends of certain upright columns (composed also of hollow blocks or "forms"), and these columns sustaining the roadway of the bridge.

A bridge is also described as being constructed in a manner similar to that last mentioned, but having frames of wood united by cross pieces, and binding pieces substituted in place of the hollow blocks or "forms" of iron. In this case the frames, or a portion of them, may be hinged together at the lower portions, which will not only end in adjusting the curvature of the arch, but will also facilitate the conversion of the structure into a " swing bridge."

As mentioned in the title of the invention the latter may be modified so as to be applicable not only to bridges, but for roofs, floors, and " other similar structures."

[Printed, 1*s*. 10*d*. Drawings.]

A.D. 1845, October 6.—N° 10,855.

HOWARD, Thomas.—" Improvements in rolling iron bars, suspension bridges, and other purposes."

This invention consists in a method of rolling wrought-iron bars " with heads or increased breadths thereon, in one entire " piece, so as to avoid the uncertain and insecure process of welding such heads on to the bars, particularly when subjected to " great strain or tension, as in suspension bridges and other " works requiring similar bars."

The mode of carrying the invention into effect may be varied, but the patentee describes a system in which the block of iron to be operated upon is first heated and then rolled in the ordinary manner until it assumes the form of an elongated slab, which is then operated upon by "heading rollers," these being rollers which are of larger diameter in some parts than in others, and so contrived as to communicate the requisite form to the ends of the slab, rendering them much wider than the middle portion, and the slabs being then elongated by other rollers which act upon this middle portion only. " When the heads are intended to be " of the same thickness as the other parts of the bar, they should " come from the heading rollers sufficiently thick to receive some " pressure by the finishing rollers, due allowance being made for " the elongation, particularly when the bars are to be employed " in suspension bridges, in order to produce the grain or fibre of " the iron in cross directions around the holes made in such " heads, when completed, by any ordinary means."

[Printed, 6*d*. Drawing. See Repertory of Arts, vol. 7 (*enlarged series*), *p.* 269; *London* Journal (*Newton's*), vol. 28 (*conjoined series*), p. 242; *and Engineers* and Architects' Journal, vol. 9 p. 184.]

A.D. 1845, November 18.—N° 10,954.

WILSON, Edward Brown.—" Improved apparatus applicable " to swivel bridges and turntables."

[No Specification enrolled.]

A.D. 1845, December 4.—N° 10,983.

RUSSELL, Henry Heathcote.—" Improvements in con" structing suspension bridges and viaducts."

The patentee says:—" My improvements in constructing sus" pension bridges consist of a peculiar mode of applying the " main chains (from which the platform is suspended by means " of suspending rods), whereby in place of the chains hanging " in curves from the upper parts of two towers or piers as hereto" fore, each chain in passing from the upper part of one tower or " pier descends to a much lower part of the next tower or pier, " and the upper chain from such tower or pier descends to the " lower part of the first-mentioned, so that the chains proceeding " from the upper parts of two towers or piers cross each other at " an intermediate position, and respectively descend to a lower " position at the opposite tower or pier, by which means suspen" sion bridges offering greater stability and freedom will be ob" tained. The construction of the details of suspension bridges " being well understood by engineers, it will not be necessary " for me to enter into any description thereof in this my Specifi" cation, and the engineer may vary the details of construction " according to his judgment, my invention being confined to the " mode of applying the main suspending chains."

Several modifications of the invention are described by reference to a sheet of drawings annexed to the Specification.

[Printed, 6*d*. Drawing. See London Journal (*Newton's*), vol. 29 (*conjoined series*), p. 24; and Patent Journal, vol. 1, p. 45.]

A.D. 1846, March 23.—N° 11,138.

GANDELL, John Hoskins, and BRUNTON, John.—" An " improvement in the construction of, and in the mode of open" ing and closing of movable bridges or arches, for the purpose " of carrying railways, tramways, or other roads across canals, " locks, docks, or other open cuttings."

In this invention a moveable trussed bridge or viaduct is mounted upon an axis resting in bearings at some distance below the roadway of the bridge, the latter being connected to the axis by means of struts or beams which pass from the lower side of the platform, converging towards the shaft, and being attached to large plates carried by the shaft, and furnished with diverging or radiating mortices, into which the lower ends of the struts or beams pass. One end of the platform of the bridge projects beyond the shaft further than the opposite end, the platform and struts thus not being equally balanced on the shaft, but the longer and heavier end of the platform, by its preponderance over the other, tending to keep the bridge in due position for traffic passing over it, that end resting, when the bridge is in use, against a strong frame placed at one side of the river or opening to be crossed, while the other or shorter end is prevented from moving by palls or strutt beams, which are capable of being drawn from under the bridge by levers, fixed upon a shaft furnished with a handle. When it is desired to move the bridge in order to allow of the passage of a vessel below, the palls are withdrawn, and the platform made to turn upon its axis sufficiently to bring the platform into an inclined instead of horizontal position, this movement taking place in the direction of the shorter end of the platform, and being produced by the pressure of water against a ram placed in a horizontal cylinder, and connected with the platform by a rod or rods. While this is proceeding, other pistons connected to the moving framework are forced into cylinders charged with water, which water is thus driven into a vertical pipe of such dimensions that the "statical pressure" of the water driven into it increases as the platform of the bridge passes farther out of the horizontal line, this arrangement not only preventing the motion of the bridge from being too rapid, but the pressure of this column of water serving (on the pressure of the water against the horizontal ram being removed) to restore the bridge to its first position.

In the case of a very wide river or opening having to be crossed two of these structures are used, their longer ends meeting over the centre of such river or opening. One piston only may be used to each bridge if desired. The roadway or platform of the bridge is supported by longitudinal timbers, carried by the strutts proceeding to the shaft below, these strutts being strengthened by diagonal braces.

[Printed, 8*d*. Drawing.]

A.D. 1846, June 2.—N° 11,236.

PERCY, William Carter Stafford.—"Certain improvements in the manufacture of bricks, tiles, chimney tops, and "other similar articles."

This invention relates, firstly, to a mode of preparing clay or other plastic material for use, whereby such material is cleared from stones or other hard substances. The material is mixed with water, and "agitated" in a pug mill or otherwise, being afterwards strained or sieved, so as to separate stones and other hard substances from it. The "so-prepared mass" is then allowed to remain in a suitable vessel until the water has separated from the clay and risen to the surface, such water being then drawn off and the clay dried for use. This drying may be accelerated by placing the clay in a reservoir mounted above a kiln in which bricks are being burnt, such kiln being enclosed, and flues therefrom passing under such reservoir, the patentee mentioning that he also proposes to use a similar arrangement for drying bricks previously to their being burned.

The invention relates, secondly, to an improved form of brick, "to be used for the prevention of damp walls, and for heating "and ventilating purposes, applicable also to bell-hanging, and "communicating pipes, flues, &c." Each brick is furnished with grooves in its surface, in some cases the grooves running lengthwise, and in others crosswise, of the brick, while in other cases the grooves cross or form right angles with each other, the bricks thus grooved being laid together in different modes, so as to cause the grooves to constitute passages for air, or for other purposes, as may be requisite.

Thirdly, the invention relates to a new form of brick for "building bridges, viaducts, tunnels, chimneys, and towers," or other structures in which "strength, mutual support and solidity "are particularly required." This brick is in fact a block, having deep notches or indentations of angular form in each side, and so constructed that when a number of such bricks are placed together, the projections between the notches of one fit into the notches of those next to it, a sort of locking of the bricks together being thus effected. An "obtuse angled bridge" is described as being formed of these bricks, and also a bridge of which the whole body is horizontal, another application set forth constituting a "doorway arch," the bricks being capable of modification "in their bearings from the perfect square to any "bevil or angle."

Another part of the invention relates to a form of brick suitable for coping the tops of walls and parapets, or other structures. In this case each brick has a projection at the upper part of one side, and a sort of recess in the other, so that when a number of such bricks are placed side by side, the projection from one overlaps the recessed part of the next, the object of this being to prevent water from lodging in the joints, the top of each brick being either hollowed or "left straight and rounded, to drain off "the water." Such bricks may be glazed to render them impervious to moisture.

Fifthly, the invention relates to forming bricks with grooves of dovetail section in their surfaces, for the purpose of causing plaster or cement to adhere more securely to such bricks when laid on such surfaces; portions of the plaster or cement being forced into the grooves.

Sixthly, to a peculiar formation of tile for draining land. This tile consists in effect of a kind of shallow box, divided into several compartments, and having openings in the top, through which, when the tile is placed below the surface of the ground, water will, in wet weather, pass into the compartments, and there remain until the weather is again dry and warm, when it will "evaporate and moisten the soil above the tile; thus imparting in "a great measure an uniformity of moisture to the soil in all "weathers." These tiles may be made of any suitable material.

Seventhly, to a machine for pressing and making bricks or tiles, or other similar articles. In this machine a frame capable of sliding up and down carries a piston having its face downwards, a second piston, with the face upwards, being mounted below it upon a vertical bar, also capable of sliding up and down, but retained at a certain elevation when not in use by a spiral spring passed round it. These pistons are both within a kind of mould, and when a brick or other article to be compressed has been placed upon the lower piston, the frame carrying the upper piston is by some suitable means caused to descend, compressing the brick or other article between itself and the lower piston, but the full amount of compression not being attained until the lower piston has been forced down to such an extent as to bring the lower end of the bar on which it is mounted into contact with another spring placed at the bottom of the machine, the resistance of this and of the spiral spring together to the descent of the upper piston effecting the requisite compression of the brick or other article. The pistons are each furnished with a groove packed with some material carrying a lubricant, which being thence distributed over the interior of the mould imparts a polished appearance to the sides of the article operated upon. The thickness of the brick or other article may be regulated by a screw, which serves to adjust the height of the upper piston in its frame.

Lastly, the invention relates to a peculiar construction of chimney top, "for the prevention of downward draughts in chim-"neys," and consists in forming openings in the chimney top with lips or projections outside, and tubes or curved pieces projecting upwards inside, any air passing through the apertures having thus an upward tendency given to it. Flanges projecting from this chimney top "carry off the water from the chimney."

[Printed, 10*d.* Drawing. See London Journal (*Newton's*), vol. 30 (*conjoined series*), p. 264.]

A.D. 1846, July 14.—Nº 11,292.

KNIGHT, George.—"Certain improvements in excavating and "dredging; also in the formation of permanent and temporary "harbours, canals, bridges, docks, and other similar works, and "the apparatus to be employed therein."

One part of this invention consists in the employment of what the patentee terms a "water fender" in the construction of submarine works, such as foundations for bridges and other structures, this fender being composed of strong convex iron plates furnished at their edges with dovetailed grooves, into which corresponding rods or laths are inserted, the plates being farther secured by transverse cast-iron supports. In conjunction with this fender "a mud or sand extracting syphon" is used, this being composed of a number of short pieces of tubing which are connected by flexible joints, and this apparatus being bolted to one of the plates of the fender in which is a culvert or hole, these arrangements affording the means of conveying sand or mud from one side of the fender to the other in forming embankments or otherwise, the syphon being provided with suitable mouth pieces, one of which is used in operating upon mud or sand, while the other is used for draining the water from material which may have been passed from one side of the fender to the other.

Another part of the invention consists in loosening and detaching fragments of rock from the bed of the sea or of a river, by connecting powerful levers or crowbars to a floating vessel, and inserting the points of such bars or levers into crevices in the rock "when the tide is just beginning to fall," the weight of the vessel, as the tide recedes, being thrown upon the ends of the bars or levers and so causing them to force a portion of the rock from its bed; the weight of the vessel being increased, if necessary, by filling it with water by means of a syphon. Masses of rock thus loosened may then be removed by the employment of a vessel furnished with a number of upright cylinders or barrels, open at both ends, and the lower ends being trumpet-mouthed, these cylinders or barrels being each provided with a windlass from which a chain passes down into the water, such chain being provided with a hook, and a number of such chains being brought to bear upon the loosened mass of rock by means of guide chains which are manœuvred from above until the hooks have laid hold of such rock, when by the use of the windlasses the rock is raised, and, by the movement of the vessel, floated into any requisite situation.

In order to afford the means of examining the bottom of the sea or of a river, the patentee employs what he denominates "an " hydraulic or submarine telescope," this consisting of two pipes or tubes, one of which is for the transmission of reflected light which may illuminate objects below, while the other is so provided with lenses as to serve as a telescope; lenses, however, being placed in the lower part of each tube in order to prevent the water from rising therein. The whole apparatus is secured to a boat, by which it may be moved from to place place, and suitable buoys are provided for keeping it in position. The illumination of the apparatus is produced by means of a "burner" and a powerful reflector fixed above it.

A.D. 1846, October 8.—N° 11,401.

FAIRBAIRN, WILLIAM.—" Improvements in the construction " of iron beams for the erection of bridges and other structures."

This invention consists " in the novel application and use of " plates of metal united by means of rivets and angle iron for " such or similar purposes, and forming by such combination " a hollow iron beam or girder."

In one modification of the invention, the sides of the beam or girder are formed of oblong plates placed side by side, and the edges united by vertical angle or T irons inside, rivets passing through these irons, through the plates, and also through "covering plates" outside. The top of the beam is formed of two or more parallel rectangular hollow chambers, composed of plates connected by ordinary angle or L iron and rivets, other angle or L iron receiving the rivets which unite this part of the beam with the sides. The united width of the chambers forming the top of the beam is greater than the space between the sides below. The bottom of the beam is formed of plates somewhat wider than the space occupied by the sides, these plates being united at the ends by covering plates and rivets, and the whole connected to the lower edges of the side plates by angle iron.

Instead of the top of the beam being of rectangular form or section it may be of elliptical section, or of any other shape calculated to prevent it from giving way in consequence of compression. Or such top may be formed of thick plates above, with lighter plates so arranged below it as to form hollow cells, which will have the effect of resisting a crushing force and keeping the beam in shape. The bottom of the beam may consist of plates, either of a single or double thickness, where a double thickness is used the plates being united to each other by "alternating or "crossing the joints," and by a mode of rivetting, which the patentee terms "chain rivetting," as "it forms an entire chain of "plates throughout the structure, and so unites the covering "plates over the joints as not to weaken or injure the plates by "transverse rivets, but to form a connecting link to each joint by "a series of longitudinal rivets or pins." Where the top of the beam is of elliptical section it may consist of a series of cast-iron tubes, connected by means of flanches in the manner of ordinary water pipes, each joint being protected by a cap or cover.

A bridge is described as being constructed of two of these hollow beams or girders to form the sides, while midway between these runs a third similar beam, all the three being parallel, and stretching from one pier of the bridge to the other, but the central beam being nearly double the strength of those at the sides. The beams are connected by transverse beams passing from each side of the central beam to the inner sides of the outer beams, the transverse beams being composed of side plates of sheet iron, connected to top and bottom plates of thicker metal by angle iron and rivets, and these beams supporting the roadway of the bridge. The main beams have the rectangular form at the top.

Beams constructed in the manner of those here described as the transverse beams are suitable for use in building mills, houses, &c.

[Printed, 1*s.* 6*d.* Drawings. See London Journal (*Newton's*), vol. 31 (*conjoined series*), p. 9; Mechanics' Magazine, vol. 52, p. 281; Artizan, vol. 4, p. 202, and vol. 6, p. 213; Patent Journal, vol. 2, p. 764; and Engineers and Architects' Journal, vol. 10, p. 143.]

A.D. 1846, November 3.—N° 11,437.

BONELLI, Gaetan.—" Improvements in bridges, viaducts, " aqueducts, and other similar erections."

According to this invention, the patentee employs " caissons, " or wedges with solid ends, united together with bolts and " screws. These caissons are each constructed in a suitable " manner for forming a regular part or segment of a large circle, " of which about the three-fifth parts of its length in the central " part bear the floor, by means of iron bars; and the floor in this " part forms the chord of these three-fifth parts of the arch. " The extremities of the arch (each of about the fifth part of the " whole arch) bear the end of the floor by means of iron circles;" " and it results from the combination of these two arrangements " that the floor of the bridge presents a long stright line, perfectly horizontal, which, according to other systems of constructing bridges, can only be obtained by other means not offering " the same strength or resistance."

As will be understood from the foregoing description, the floor of this bridge is not placed on the top of the arch, but passes in a horizontal line some distance below it, the middle or highest parts of the arch being above the floor, and a considerable portion of the arch near each end being lower than such floor. On the end portions of the arch, below the floor, the " iron circles " (which are in fact " spandrils ") rest, and sustain that part of the floor above them, while from the middle portion of the arch, which is above the floor, suspending bars descend, which carry beams supporting the middle portion of the floor. These bars are not arranged vertically, but converge to a point below the arch, the patentee stating that this arrangement nearly if not wholly prevents the oscillation which exists under the ordinary system of arranging suspending bars. Longitudinal iron bars pass through the floor, from end to end of the bridge, and are strongly fixed in the piers or abutments, "such bars forming the "chord of the arch, and consequently retaining the butments by "resisting the effect of the thrust of the arch."

In the case of a viaduct, "the necessary additions for a water-"way" must be made to the arrangements described above.

[Printed, 10*d*. Drawing. See Patent Journal, vol. 2, p. 840.]

A.D. 1846, December 21.—N° 11,501.

OSBORNE, Richard Boyse.—(*Partly a communication.*)— "Certain improvements in bridges, roofing, and flooring."

This invention consists, firstly, "in substituting for the solid "beams ordinarily used in the construction of iron bridges and "other iron structures, which are of large span between their "piers or other points of support, frame beams of numerous "pieces combined or trussed together in such a manner that the "direct transverse strain to which solid beams are subjected is "resolved into a series of tensile and compressing or acting and "counteracting forces, and such frame beams may be made of "greater length and strength than solid beams, and raised into "their places with more facility, and whereby also a large saving "of material and labor will be effected." An arrangement is described in which each side of a bridge consists of an upper and lower horizontal beam, connected together by diagonal bars and vertical tie rods. Each of the horizontal beams is composed of three pairs of flat bars placed on edge, the upper range of bars being bound together by a "cap piece" above and a clamp below, and bolts passed through the whole, while the lower range is bound together by clamps, both above and below, and bolts. The ends of the vertical tie rods, which are arranged in pairs, pass between the several pairs of bars forming the upper and lower beams, and through triangular blocks let into the inside edges of the beams, being secured by nuts and plates or washers on the outsides of the latter, and against the sides of these triangular blocks rest the ends of the diagonal bars, which come between the vertical tie rods. Two diagonal bars crossed by a single bar passing between them are placed between each pair of vertical rods, the double bars being inclined first in one direction and then in the other alternately, and the single bars being arranged in correspondence therewith. The ends of the structure are strengthened by "vertical posts" being introduced in place of tie rods, and the ends of the lower beams rest upon rollers mounted upon cast-iron boxes supported by the piers, this arrangement allowing of the expansion and contraction of the structure arising from changes of temperature. In a somewhat different arrangement of bridge, the upper and lower beams are each composed of four flat bars placed edgewise at equal distances asunder, and united by vertical posts and diagonal rods, the rods in this arrangement occupying the position of the diagonal bars in the first, the vertical posts corresponding with the tie rods. The floor of the bridge is apparently meant to be carried along cross bars supported by the lower horizontal beams. These arrangements may be used in other structures of " large span " as well as in bridges, an arrangement being described as applicable more especially for supporting a roof in which the structure is of curved form, constituting a kind of arch, and resting upon pillars, being strengthened by a long horizontal tie rod below, and a vertical tie rod passing from that to the centre of the arch.

Another part of the invention consists " in certain modes of " curving or cambering frame beams constructed as aforesaid, and " keeping them after erection of any given curve or camber, or " preventing them when made straight from swagging." One mode of effecting this consists in marking upon the upper and lower beams, when in a straight state, the points at which the different tie bolts ought to be introduced, " to suit the radii of the " required curve," these points of course being further asunder in the upper than in the lower beam. A pair of vertical centre posts are then introduced between the two beams, at the middle thereof, and the diagonal bars and tie rods are then introduced in succession, commencing from the centre posts on each side, the tie rods, as screwed into their places, causing the beams to assume a curved figure. Where the curvature required is only small the effect may be produced by employing diagonal braces of different lengths, the " divisional spaces " in the beams being equal. The patentee mentions that in " forming centering for stone bridges " over deep and rapid waters this will be found a very simple, " efficient, and economical mode of construction."

[Printed, 1*s*. 2*d*. Drawings.]

A.D. 1846, December 23.—N° 11,509.

GOUGY, Pierre Frederick.—" Improvements in apparatus " and machinery for raising, lifting, and otherwise moving heavy " bodies."

One part only of this invention requires notice here, this consisting of "a mode of constructing temporary bridges suitable "for moving heavy bodies across rivers, canals, creeks, ditches, "and in which they may be submerged when out of use, and "raised at pleasure when their services are required."

The roadway of the bridge is composed of longitudinal parallel beams, which rest upon certain "balloon vessels," these being hollow vessels formed of wood or metal, of any suitable shape, and, when filled with air, floating on or near the surface of the water and sustaining the bridge above it, but such vessels having apertures in their lower sides, through which water can be admitted for the purpose of causing them to sink, the bridge then descending with them, and the whole being again raised when requisite by pumping air into the vessels from above, such air expelling the water from them and so rendering them buoyant. This air is introduced into the vessels from above through pipes connected to them, and which at all times extend to above the surface of the water, these pipes being then closed by stop cocks, which retain the air in the vessels until they are required to again sink, when the opening of the cocks will allow the air to escape from and water to again enter the vessels. Strong piles are placed at each end of the bridge, which form guides thereto during its ascent and descent, and on each side of the bridge is a railing which is jointed or hinged thereto, and so connected to certain floats that on the apparatus sinking, the floats cause the railings to fold over the bridge, but to assume an upright position when it is again raised. The beams forming the roadway of the bridge may either be so connected as to constitute a rigid platform or framework, or they may form several separate platforms, and be jointed together by hinges.

[Printed, 1*s*. 10*d*. Drawings. See Mechanics' Magazine, vol. 50, p. 405; and Patent Journal, vol. 3, p. 129.]

A.D. 1847, April 8.—N° 11,650.

MOULTON, STEPHEN.—(*A communication.*)—"Improvements "in the construction of bridges."

According to this invention each side of a bridge is composed of a "top rail" and a "bottom rail," extended horizontally, and combined together by diagonal bars which cross each other, and are connected at their ends to the horizontal rails by screw pins,

" other, in such manner as to support a roadway at their lower " or upper ends, or at both ends." These plates, bars, or rods are so connected at their ends as to form a series of triangles, of which the bases are upwards and constitute a horizontal line, the apexes of the triangles below being connected by longitudinal bars or links, two or more series of these plates, bars, or rods, and connecting bars or links, being placed over the river or space to be crossed, and secured together by transverse bolts or rods, and a bridge being thus formed which is capable of carrying either one or two roadways, one at the top, and (if two are necessary) one at the bottom, the latter being inside the structure.

Instead of the plates, bars or rods described above upon cast-iron triangular frames may be used, which are jointed together or connected by plates sunk into recesses formed to receive them at the corners of their bases, the latter being upwards as before, and the apices being connected by "tension plates." In each of these arrangements the structure is so contrived that the bars at the ends of the structure are vertical, the end triangles being only half the size of the others, and these vertical bars rest against perpendicular abutments rising from the piers on which the structure rests, these abutments preserving the parts of the structure in their places. For light bridges for foot passengers a series of wrought-iron triangles may be used, secured together at the top by compression bars or tubes, being, when bars are used, hooked upon the ends of cross bolts which project beyond such bars, or, in the case of tubes, being attached thereto by bolts in the interior thereof. In this case the apices of the triangles are apparently meant to be upwards, and a single roadway to be carried along cross bars, which unite the several bases of the triangles together.

A modification of the second arrangement is described as specially applicable to carrying a single roadway in which the apices have each, in the inside of the structure, a bracket, saddle, or recess, there being for the purpose of sustaining transverse girders which support the road.

According to another part of the invention a bridge is constucted by means of a series of cast-iron framings, "placed trans- " versely and in angular positions with each other," and connected by longitudinal bolts or rods, girders on the top of the structure keeping the transverse frames sufficiently apart, and also supporting the roadway of the bridge; a second roadway being formed if necessary at the bottom of the structure.

Another mode of constructing a bridge is described as consisting in the use of several series of plates or bars of iron placed in angular or diagonal positions, and bolted to "compression" rails at top and bottom, the "spread" of these plates being regulated by longitudinal bolts and nuts, the lower part of the structure carrying transverse girders which support the roadway. On the top of each upper "compression" bar or rail are two "bearing "blocks," placed at some distance asunder, a straight bar or rod passing from one of these blocks to the other, and diagonal rods passing from the blocks downwards to the piers of the bridge, this part of the arrangement strengthening and stiffening the structure.

In aqueducts, waterways are constructed "in place of roadways," but no particular application of the invention either to aqueducts or roofs is described.

[Printed, 1s. Drawing. See Mechanics' Magazine, vol. 50, p. 185; Artizan, vol. 7, p. 184; and Patent Journal, vol. 6, p. 198.]

A.D. 1848, September 4.—N° 12,260.

NASMYTH, George.—"Improvements in the constructing of "fireproof flooring and roofing, also applicable to the construc- "tion of viaducts, aqueducts, culverts, &c."

One of the essential features of this invention consists in the employment of a "metallic arch or other curved or angular figure, "or both, supported by a metallic chord constituting the abut- "ment of the arch," in the construction of girders for bridges and aqueducts, and other structures, and in the formation of fireproof floors and roofs.

Various modifications of this part of the invention may be employed. A girder for a bridge is described as being constructed by first bending one or more bars of metal into a curved or arched form, such bar or bars being then preserved in that form by straight bars, constituting the chord of the curve or arch, the ends of these bars being turned up in the manner of hooks, and so preventing the curved bar or bars from resuming the straight form when subjected to superincumbent pressure. In connection with this part of the structure there are then arranged side plates, extending the whole length of the girder, and connected together by a curved bar or bars, so bent as to fit upon the upper surface of those first mentioned, this upper range of curved bars and the side plates enclosing the lower curved bars and stays or chord bars, and the girder being then furnished with "end pieces." If the girder should be of such a length that the chord bars have a tendency to "sagg" or sink in the middle, they may be sustained by suitable supports. The patentee mentions that this system may be employed in trussing wooden beams.

In constructing floors and roofs bent plates or bars, with tension or chord bars, are arranged so as to be sustained by girders formed as described above, or by cast-iron girders, having flanches at the top and bottom, or otherwise shaped. A floor may be formed above the curved bars or plates by a filling of concrete or cement, upon which tiles or boards may be laid; or plates of metal resting on their edges, or hollow earthenware pipes, may be placed upon the curved bars or plates, in which cases less filling will be required, and the structure consequently rendered lighter.

Instead of the bent bars or plates having a curved or arched form given to them they may be "polyagonal," or of other shape, but in all cases are made to retain the figure given to them by the use of the tension or chord bars. Instead of the latter being turned up at the ends they may (if preferred) be furnished with toggles to retain the ends of the bent bars, and may further be connected to them by bolts or rivets; or chains or ropes may be used in place of the tension bars, and where cast-iron girders are used, "retaining pieces" may be attached to the girders, the more effectually to prevent any change in the figure of the bent bars. Corrugated metal may be used if desirable for the curved plates or bars, and also for supporting a floor above such plates or bars, all the details of the invention being capable of different modifications.

Another part of the invention consists in constructing the supports of a floor of curved plates and cord plates, and employing the space or spaces between such curved and chord plates as passages for the conveyance of currents of air, for the purpose of "warming, cooling, and ventilating" the building in which such floor is placed.

[Printed, 1*s*. 2*d*. Drawings. See Mechanics' Magazine, vol. 50, p. 235; Artizan, vol. 7, p. 207; and Patent Journal, vol. 6, p. 223.]

A.D. 1848, October 12.—Nº 12,286.

DE BERGUE, Charles.—"Improvements in bridges, girders, "and beams."

This invention consists, firstly, "in a peculiar mode of con- " structing a compound tension rod or bar, to be employed as a " substitute for chains in suspension bridges." This tension rod or bar is composed " of plates of steel, or wrought iron, or wrought " iron and steel rivetted together." In employing these tension rods or bars in the construction of a bridge, they are stretched from side to side of the river or place to be crossed, the ends being firmly secured to the underside of large castings supported by masonry, and the tension rods or bars (two of which are used, being laid parallel to each other) bearing against the lower ends of vertical struts, which are composed of oblong plates of metal, extending upwards from the tension rods or bars to a series of iron pipes placed end to end, and forming the upper portion of the structure. These pipes are of different diameters, those in the middle of the structure being larger than the others, which gradually diminish in size to the ends, and each end pipe having cast with it a large projection, extending along the whole length of its lower side, and having a flanch at its outer extremity, by which means it is connected to one of the castings mentioned above, the latter having corresponding flanches. These pipes are so constructed that on being put together each series (one series being on each side the bridge, over a corresponding tension rod or bar,) assumes a somewhat curvilinear form, the middle parts being the highest. The plates forming the vertical struts are of such breadth as to extend at their upper ends completely across the flanges of the pipes, between which they are inserted and secured by the same bolts which connect the pipes. The outer edges of these struts are furnished with angle irons, and outside these again are other plates which pass over the upper parts of the flanges of the pipes, and are bent round them so as to cover and protect the joints. The roadway of the bridge is supported by plates of iron, strengthened by angle iron at the edges, these plates forming transverse girders extending across the bridge, and rivetted at each end to the lower parts of the struts. Between these transverse girders, again, are longitudinal girders, supporting longitudinal sleepers, on which rails or a roadway may rest.

If it should be found difficult to procure plates of steel "of " sufficient breath in one piece" for the construction of the tension rods or bars when such are required to be of steel, a series of narrow plates may be used, which may be rivetted upon a single wrought-iron plate. Instead of using pipes for the upper parts of the structure, beams of timber, composed of a number of pieces of that material, placed side by side, and secured together by metal plates and bolts, may be used, the struts being in this case connected with these plates on the outsides of the beams, and also with plates passing up through the middle portions of the latter. In both these arrangements the structure is furnished with diagonal bars or braces, rivetted to the struts at their lower ends, and attached to the pipes or beams by bolts, which latter may be slightly eccentric in section, so that when turned into different positions they will draw the diagonal bars more or less tight. An arrangement of bridge is described in which suspension rods proceed downwards from a compound tension bar formed of plates of steel rivetted to plates of iron, the compound tension bar here coming in place of the chain usually employed in a suspension bridge to sustain the platform, and the suspension rods being connected at their upper ends with the tension bar by saddle pieces and pins, and supporting at their lower ends a suitable platform or roadway.

The second part of the invention consists in rivetting plates of steel to the lower sides of beams or girders, for the purpose of strengthening the latter without adding greatly to the weight. Different modifications of this part of the invention are described.

[Printed, 1*s*. 10*d*. Drawings. See Mechanics' Magazine, vol. 50, p. 378; Artizan, vol. 7, p. 230; and Patent Journal, vol. 7, p. 13.]

A.D. 1848, December 9.—N° 12,360.

GARDNER, John.—" Improvements on girders for bridges and " bridges and other structures."

This invention consists in making girders for bridges and other structures " of cast iron, with a strengthening or additional bar or " bars of wrought iron embodied or dovetailed into the same."

According to one modification of this invention the girder consists of a straight beam, with narrow flanges along the top, and broad flanges at the bottom, the latter, however, not extending continuously along the whole length of the girder, but constituting a succession of broad feet on which the girder may rest. Two wrought-iron bars are introduced into the bottom of the girder at a little distance apart, these bars extending the whole length of the beam, and being " at the centre of each flange slightly bevilled " outwards on each side, so as to be in those parts dovetailed, as " it were, into the girder." These are introduced in the process of casting the girder, having proviously been rolled out into the required sectional form, "and well cleaned of oxide by heating "them in a furnace or otherwise."

According to another modification one bar only of wrought iron is introduced, "which forms the entire bottom of the girder, "and is connected to the upper part by a central ridge of a "dovetail form in its cross section, and of an undulating shape "in the longitudinal direction."

"Various other modifications in the form of the wrought-iron "bars may suggest themselves, and may be adopted without "prejudice to the principle" of the invention.

Two modifications applicable to "railway bars and bearings" are represented in the drawing annexed to the Specification. In one of these the "wrought-iron parts" form the rails upon which the trains run, these parts being partially embedded in the "cast-"iron parts," and the latter being apparently meant to serve the purpose of "chairs," being in this case flat, or nearly so, on the lower or under side. In the other modification the wrought-iron parts are partially embedded in cast-iron parts, which are curved in the form of an arch.

[Printed, 6*d*. Drawing. See London Journal (*Newton's*), vol. 34 (*conjoined series*), p. 399; Mechanics' Magazine, vol. 50, p. 560; Patent Journal, vol. 7, p. 109; and Engineers and Architects' Journal, vol. 12, p. 350.]

A.D. 1851, February 10.—N° 13,500.

NORRIS, RICHARD STUART.—"Certain improvements in the "construction of the permanent way of railways, bridges, locks, "and other erections wholly or in part constructed of metal; also "improvements in brakes for railway carriages."

These improvements relate, firstly, to "a method of joining "together, fastening, or supporting the bars of railways, various "parts of iron bridges, locks, and other erections, and consists in "effecting such object by casting molten iron, or other suitable "metal, upon or about the said rails or other parts intended to "be joined, fastened, or supported." The patentee states that the apparatus used for effecting this part of his improvements may be "of any ordinary suitable construction, and may be "extended to a great variety of applications," but he describes certain modes of effecting these objects as being preferable to others. One of these consists in the employment of a metallic mould, the hollow interior of which is so shaped as to form a mould for a railway chair, openings in the mould being provided for the reception of the ends of two adjoining rails, and for pouring melted metal into the mould, as also for the escape of air therefrom during the process. The ends of the rails being passed into the moulds, molten metal is then poured into the latter, this molten metal, when cooled and hardened, both uniting the ends of the rails and forming a chair for the permanent support thereof. Spike holes are formed in the feet of the chair by passing certain pins down into the mould, which pins are afterwards withdrawn. Chairs for supporting the middle parts of rails may be formed in a similar manner, and " other constructions may be in like manner " cast."

Instead of metallic or "chill" moulds being used, moulds of sand or other material may be employed if desired, and similar arrangements may be adopted in "fastening a chair (which has " been cast in the ordinary manner) to a railway bar, by casting " iron or other suitable metal into the space usually occupied by " the tightening key or wedge. In order to effect this the wooden " or other key or fastening is withdrawn, and pieces of wood or " other suitable material placed at each end of the now vacant " place." For securing the ends of the girders of bridges in the mortices of their bed plates a " loam plate," or thin plate of any suitable material is placed so as to cover that part of the mortice which remains open after the insertion of the end of the girder, molten metal being then poured into the mortice, and uniting the girder to the bed plate. The footsteps of lock gates are also secured in the " foot boxes " by similar means, and " various other " portions of metallic erections joined or supported."

In cases where it is necessary to provide for the expansion and contraction of the parts, a piece of canvas, upon which has been spread a coating of loam and lime, is interposed " between the new " casting and those parts intended to be joined or supported."

These modes of carrying out the invention are mentioned as being of an ordinary character, but the patentee describes a " portable cupola for melting the metal to be cast upon the spot " where it is desired to be used," which he claims as forming part of his invention. The band of this cupola is " composed of " sheet metal, and lined with fire-bricks or fire-clay." It is provided with a door of the usual construction, and a spout; also with handles "for the convenience of lifting," and to the upper parts are attached standards, upon which ladles may be placed in order to keep them in a heated state. The cupola thus formed is attached by means of bolts to a framing, upon which is also affixed the casing of a rotary fan. The casing of this fan has plates rivetted thereto, which plates are united by means of bolts to angle pieces attached to the sides of the cupola. It is also furnished with a pipe projecting forward through an orifice formed in the barrel of the cupola. The fan is provided with a driving pulley and band, by which rotary motion may be given to it from certain apparatus which is arranged to be turned by hand.

This apparatus may be readily conveyed from place to place, and it may be applied to the purpose of " casting ordinary railway " chairs or other parts of railways, portions of bridges, locks, or " other erections, upon or about the spot where such articles are " required to be used."

[Printed, 10*d*. Drawings. See London Journal (*Newton's*), vol. 42 (*conjoined series*), p. 4; Mechanics' Magazine, vol. 55, p. 139; Engineers' and Architects' Journal, vol. 16, p. 72; Artizan, vol. 9, p. 239; Patent Journal, vol. 11, p. 245.]

A.D. 1851, December 8.—N° 13,850.

PIDDING, William.—" Improvements in the treatment, manu- " facture, and application of materials or substances for building " purposes."

One part of this invention relates to superseding the use of ordinary bricks in the construction of bridges, breakwaters, and other structures by substituting in place thereof bricks, blocks, or other " shapes " composed of certain materials, which may either be united by cements of " known use," or by cements described by the patentee, and the composition of which forms another part of the invention. The invention will be best understood from the following abstract of the Specification:—

" I will commence by stating that I make bricks, slabs, blocks, " tiles, pipes, or other forms or shapes from combinations of " broken stone, scoria, muriate of alumina, or acetate thereof, " mineral earths, fluxes, wood or wood dust, commonly called " sawdust, coal, coke, papier maché, naptha, vegetable fibres, " pitch, glue, gutta percha, and other articles possessing the " requisite properties, which I combine in combinations of several

" of the foregoing articles, or separately or individually with " cement." " I also veneer blocks, slabs, bricks, or other forms " made according to my invention, where desirable, on one or " more edge, face, or end thereof, with slate, stone, marble, or " other suitable substance or material of any desired thickness, " and cause such veneers to adhere thereto or therewith by certain " cements to be herein-after described."

" Again, I take ordinary bricks," " and cover or coat them with " a coating of pipe clay, porcelain clay, or any other clay of a " superior nature, which, when glazed, will make them appear to " be composed of solid porcelain, or white or other colored clay." " The clay is prepared with a proportion of about twenty per cent. " of soda ash, or sulphate thereof, and I apply the clay " " to the " bricks as a coating either before or after they are dried or burnt, " as in practise may be found most expedient." " I also improve " the appearance of bricks, tiles, slabs, or other figures or sub- " stances by coating or facing the same with cement; or I take " sulphate of alumina and deprive it of its water of cristalization " when rendered semi-fluid by heat and press them into a mould " of the shape required. I then saturate them with silicate of " potash, and subsequently subject the bricks to a great heat, and " I make cases of thin metal, which on being placed together will " form the article to its desired shape." " I sometimes steep the " sulphate of alumina in resin, or any bituminous substance, when " desirable, for the better effecting the adhesion of the substance " from which the bricks, slabs, or other building materials are " composed. Another mode of rendering bricks more durable, " firmer, and fitter for sewers, canal beds, and other places where " complete imperviousness to moisture without great increase in " the cost of such bricks or other forms is desirable, is to prepare " a composition of finely ground or precipitated silica, with about " one-fourth of its quantity of soda or potash, subjecting the " mixture to such a temperature as will cause it to fuse. I then " varnish bricks and other building materials with any common " varnish, and apply this composition thereon as a coating, and " then re-fuse or char them; or, where it is desired to have the " bricks of any particular color, I take such mineral coloring " matter as will produce the color desired," " mixing the same " with the composition of silica and potash, and otherwise pro- " ceeding as before described. Or, if a plain or colored glaze only

" is required to be placed on the materials, prepare a sufficient " quantity of plain or colored glass reduced to power, placing a " sufficient quantity thereof in a tub or other vessel, and after " varnishing the bricks or other materials plunge them therein, or " apply the powder to the varnished bricks in any other convenient " way. The glass" "may then be fused, so as to give the bricks " a crystal coating."

"I will now describe the cements I use for the purposes men- " tioned in the foregoing." "I take of burnt sulphate of alumina " twenty per cent., of burnt sulphate of lime seventy per cent., and " and of silica, very finely pulverized, or, if preferred, precipitated, " ten per cent. (or where it is more convenient borate of soda may " be used instead of and in the same proportion as the alumina). " Then have ready half a ton weight of gypsum (sulphate of lime), " burning the same for about the space of two hours to extract or " drive off the water." "I permit the sulphate to get cold, and " having prepared a solution of about three and a half ounces of " sulphate of alumina to one gallon of water, with which I satu- " rate the sulphate of lime," "I afterwards subject this composi- " tion in a kiln to a white heat for some hours, and when it is in " a fit state I reduce it to an impalpable powder and mix there- " with about ten per cent. of the following preparation; say, of " good flint stones one ton, burnt until they attain a very bright " red color; when this has taken place remove them from the " furnace and allow the stones to cool down a little;" "then pour " thereon cold water in sufficient quantity to disentegrate or " separate the particles, taking care so to regulate the quantity of " water that while it serves the above purpose it does not so " saturate and cool the stones as to prevent them drying by the " coloric they should still retain."

"I also make a cement," "composed as follows:—Silica pre- " pared by either of the before-mentioned processes and mixed, " when dry, with linseed oil or common driers, or without the " latter, in the proportion of about nine-tenths silica to about " one-tenth of linseed oil, and about one per cent. of driers." " I also make bricks," "and other forms or shapes, by burning " coal into coke in a mould, adding thereto any of the cements " or varnishes herein-before described." " I also mix intimately " proportions of coke, charcoal, cinders, or anthracite with certain " quantities of coal composed of particles about the size of a pea.

" The proportions must depend on the nature of the coal, or
" instead of coal any carbonaceous material may be used " " for
" the purpose of making slabs, pipes, or other forms of articles
" for building; and where I find it desirable in the production of
" this brick I use (but always with the coke and other before-
" named materials) any of the articles herein-before mentioned,
" such as vegetable fibres, pitch, sawdust, &c. Whatever be the
" component parts they are placed in moulds," " and subjected to
" a moderate pressure or compression, and then placed in or
" surrounded with sand in a furnace, the temperature of which is
" gradually raised to a red or even to a white heat." " I also
" combine any of the materials herein-before mentioned with
" gutta percha or with marine glue, using one article in combina-
" tion therewith, or several thereof, for the purpose of obtaining
" solid, light, economical, and impervious substances for building
" purposes generally, and for breakwaters, ships, and other
" vessels."

[Printed, 4*d*. No Drawings.]

A.D. 1852, August 26.—N° 14,278.

COWPER, CHARLES.—(*A communication.*)—" Improvements in " the application of iron to building purposes."

This invention relates, firstly, to the manufacture of rolled wrought iron beams for building purposes, " with two or more " bearing surfaces in their bottom flanges, and the application of " such beams to the construction of floors, roofs, beams, and " similar structures;" and also to a mode or modes of " fitting " and uniting such beams to each other." Each of these beams is composed of a vertical web, having flanges on each side of the top and bottom, the lower flange having in it a " step," which causes it to offer more than one bearing surface. The ends of such joists or cross beams as are meant to be united to these beams are cut so as to fit the sides of the latter, and are secured thereto by pins.

Another part of the invention relates to the rolling of wrought-iron joists composed of a vertical web with flanges at top and bottom, the bottom flange not being stepped as in the case of the beams mentioned above, but forming one horizontal bearing on each side of the web, the lower portion being rounded. The vertical web of these joists is thicker at the upper and lower parts than in the middle. An application of these joists is described in which flanged bearers are laid across them to sustain a floor, such bearers being recessed at the parts which rest upon the joints, and the upper sides of these bearers being level with the upper surfaces of the beams which support the joists, while wrought-iron bars are used as "ceiling joists," the ends of these bars next the principal joists being bent upwards in such manner that when in position their lower sides are somewhat below the lowest parts of the flanges of such joists.

Different applications of these beams and joists to building purposes are described, bars of **T** section being used to keep the joists the proper distance apart. Bars rolled of a similar section to those used for joists may be used in the construction of window frames.

After describing the application of the joists, bearers, and wrought-iron "ceiling joists" in the construction of a floor, as mentioned above, the patentee states that by employing "wrought-" iron bars of proportionate strength a floor of this sort may be " employed as a bridge," but no special application of the invention to the construction of a bridge is set forth, nor is the invention in all respects clearly defined.

Another part of the invention relates to the construction of " hollow wrought-iron beams or breast summers and door-posts " and columns." These are each composed of two bars having projecting ribs on one side at a short distance from the edges, which bars, being placed opposite to and at a certain distance from each other, with the ribs inwards, have placed between them, so as to rest upon the ribs, two plain bars, the whole thus forming a kind of square tube, and being secured together by iron hoops or bands.

Another part of the invention consists in the employment of certain rolled bars in the construction of window frames. From the description given it appears that an exterior frame is first composed of bars having a rib or flange projecting inwards, and that in this are placed two other vertical frames, of which the tops and bottoms and outer sides are composed of bars having a rib or projection against which the glass is to be fixed, while the inner sides of these frames, which meet in the centre of the window, are composed of bars so formed that one partially enters a recess in the other, a "pipe" at the bottom of the window being arranged to carry off water. The outer sides of the two vertical frames are furnished with ribs, which enter grooves in the inner sides of the exterior frame, "for the purpose of preventing the passage of wind " or rain when the window is closed," the patentee says, but according to the description given the window could not be opened.

[Printed, 1*s*. Drawing. See Mechanics' Magazine, vol. 58, p. 236.]

A.D. 1852, September 18.—N° 14,298. (* *)

WARREN, JAMES, and WALKER, BERNARD PEARD.—"Improvements in the manufacture of screws and screw keys, and " in the construction of bridges, applicable to floorings, roofings, " and paving."

That part of this invention which requires notice here is thus described:—

"Our improved mode of constructing bridges and flooring is by " forming them of surface plates of metal, wood, or other material, " which may be grooved or tongued together at their edges, and " be of any suitable form, having supports attached to the under " sides, tied together by iron rods. Another method is by making " the flooring or bridge of wrought-iron plates of a square form, " bent at right angles across the diagonal. Two of these plates " are then bolted together, and the triangular piece hanging down " is connected to similar pairs of plates by iron tension rods. By " the use of this flooring girders may be dispensed with, and " where metal only is used a fireproof construction is obtained at " a moderate cost."

These plates may be "bolted or rivetted together in pairs," with a piece of iron interposed "which, projecting from beyond " the plates, acts as a support for the corner of the next adjacent " plate, and thereby prevents its being bent downwards by use."

[Printed, 10*d*. Drawing. See Mechanics' Magazine, vol. 58, p. 276; and Engineers' and Architects' Journal, vol. 16, p. 186.]

PATENT LAW AMENDMENT ACT, 1852.

1852.

A.D. 1852, October 2.—N° 165.

POOLE, Moses.—(*A communication from Monsieur Vergnias.*)—"Improvements in constructing bridges, viaducts, and such like "structures."

This invention consists in suspending a roadway or platform by means of compound arches composed of sections made of cast iron, the curved plates used in making the arches having projecting ribs intermediate of their width; the "compound arches "preventing undulation, and the projecting ribs preventing "oscillation."

Several bridges constructed according to this invention are described by reference to drawings which accompany the Specification. In each case the arch consists of a "main arch," stretching from pier to pier, and two "secondary arches," the latter consisting of short curved portions connected at one end to the pier and at the other to the main arch, which it thus strengthens, preventing "pressure at the centre causing it to rise at the "haunches." The platform which carries the roadway is suspended from the arches by vertical bars, such platform being composed of ribbed wrought-iron plates.

[Printed, 8*d.* Drawings.]

A.D. 1852, October 23.—N° 506.

MARCHANT, Robert Mudge.—(*Provisional protection only.*)—"Improvements in the construction of bridges."

This invention consists in the use of a combination of cast iron and wrought iron, or of cast iron, wrought iron, and wood. The cast iron is employed "in compression," and the wrought iron or timber "in tension."

[Printed, 4*d.* No Drawings.]

A.D. 1852, November 8.—N° 672.

CAREY, STEPHEN.—" Certain improvements in the construction " of viaducts, arches, bridges, and other buildings upon a non- " expansion principle."

This invention consists " in the peculiar formation of bridges, " viaducts, arches, foundations, floors, roofs, girders, sleepers, " sea or river walls, lighthouses or forts, bottoms of docks, and " all or every part or parts of any construction or constructions " to which the same can or may be applied, by means of blocks, " castings, plates, or other substances, moulded or formed " geometrically upon a non-expansion principle."

Different modifications of these blocks, castings, or plates are described, but in all cases the blocks or castings are formed with recesses in the sides, the end portions of such sides thus forming projections, and the effect being that a number of these blocks may be laid down in such manner that the projecting portions of one will enter the recesses of those on each side of it. Moreover, the sides, and the ends also, including the inner edges of the recesses of some of the blocks, are convex, and of others concave, and the result of the whole arrangement is that, when a series of these blocks are placed together, " each casting is thereby dove- " tailed to the other, and each therefore acts as a truss, support, " or binder to the other."

These blocks may be either hollow, or solid, and may be further secured together by bolts, pins, " metal plates, cements, or other " suitable material through and against the ends or sides thereof, " and for the purpose of giving greater strength, bars or chains " of iron may be passed horizontally or diagonally through the " said blocks or castings, and which will prevent expansion." The blocks may be formed of iron, wood, stone, clay, " or alternate " layers of iron, wood, stone, or clay, or all or any of them, or such " other material or materials as may be found best adapted for the " purpose," and, if necessary, openings may be formed in the blocks for the passage of gas, water, and other pipes.

No particular application of this invention to the construction of bridges is set forth.

[Printed, 10*d*. Drawings.]

A.D. 1852, December 4.—N° 963.

PARRATT, George Frederick.—(*Provisional protection only.*) —" Improvements in portable bridges or pontoons."

This invention consists in the employment of air-tight flexible tubes in combination with a system of cross bars, the air-tight tubes giving buoyancy to the apparatus, and the cross bars " offering a roadway, or supports for a roadway."

[Printed, 4*d.* No Drawings.]

1853.

A.D. 1853, January 29.—N° 235. (* *)

BATCHELOR, Henry.—(*Provisional protection ouly.*)—" This " invention relates to the construction of iron ships and vessels, " boilers, tanks, bridges, and other receptacles and frameworks, " by combining together two or more thicknesses of metal plates " crossing each other at right angles, or at some other interme" diate angle. The plates are laid face to face, and are rivetted " or otherwise connected together in the ordinary manner, forming " a species of duplex or triple plate." By this arrangement the work is materially increased in strength, owing to the favourable angle of the plates bringing the strain across the strongest direction of the fibre.

[Printed, 4*d.* No Drawings.]

A.D. 1853, January 29.—N° 241.

LAVANCHY, Jean Baptiste.—" Improvements in the con" struction of collapsable framework of wood or iron, which may " be employed for forming portable bedsteads, houses, parts of " houses, or bridges, and other similar structures, which may " occasionally be required to be removed from place to place " with facility, economy, and despatch."

The object of this invention is effected by " constructing the " framework of a series of levers, combined together on the prin" ciple of the lazytongs, and so arranged that the several parts " will shut up close, and when required for use may be extended

" out, and when combined with other similar collapsable frames " may form a structure of any convenient length. In order to " prevent too great a strain on the joints, stops are placed at each " end of all the levers, so as to prevent them from extending " beyond a certain distance, and in some cases the frame is " further strengthened by adapting to the upper end a horizontal " rail as an abutment or strut."

" In constructing bridges, the flooring or planking may with- " out inconvenience be attached to the levers, so as to fold up " with them in a similar way to the parts of a fan or a Venetian " blind. In this way a bridge of moderate span may be carried " about with convenience, and may be thrown across a river in " a few minutes after placing the framework in its closed-up state " on a boat, barge, or other floating vessel, from which the ends " of the framework are extended to the shore, where they must " be secured in any suitable manner."

A bridge is described in which the levers are connected to a series of upright grooved or slotted bars, " in the slots or grooves " of which certain of the joint pins of the levers are made to work, " and whereby the rigidity, strength, and firmness of the structure " is considerably increased," these upright bars, moreover, supporting a hand rail, chain, or cord, " to prevent persons from " accidentally falling over."

[Printed, 10*d*. Drawings.]

A.D. 1853, January 31.—N° 247.

PERKES, Samuel.—" Improvements in the mode of construct- " ing certain works applicable to aqueducts, viaducts, railways, " canals, rivers, docks, harbours, lighthouses, breakwaters, reser- " voirs, tunnels, sea walls, embankments, submarine foundations, " and other useful purposes."

The first part of this invention consists in " a peculiar mode of " constructing timber bridges for roadways, &c.," which is effected by " combining together a quantity of boards or thin planks edge- " ways in a vertical position." In describing the details of this part of the invention the patentee says :—" The first thickness of " such boards or planks consists of what I term bearers, being " plain boards on their edges set one over the other of any " required depth, according to the span or opening and the sup-

“ posed weight such structure will be required to carry, and such “ boards to have their joints broken all through as far as possible. “ The second row or thickness I term binders, and secure to the “ first row at an angle of about 45 degrees; the third row “ (videlicit) bearers I arrange similar to No. 1 row, only as far as “ possible break joint with them; No. 4 row (videlicit) binders I “ fix also at an angle of about 45 degrees, but in the opposite “ direction to the angular binders in No. 2 row; and so continue “ on with as many thicknesses as may be required either to construct the bridge, &c., in one solid mass the whole width of “ such bridge, or in separate beams for supporting a platform.” He then goes on to say that these details may be varied, that the binders may be placed at different angles, that the “beams or “ bridges” may be “either flat or of any kind of arch as may be “ required,” and that they may be covered with timber, or with metal plates, or both, a roadway being formed thereon of the usual materials; beams or bearers of this description being also applicable for the support of the roofs of buildings, as well as for the construction of portable bridges for landing troops or mercandize from vessels which cannot “get to shore,” the beams being for this purpose made in convenient lengths, and provided with “iron joint sockets and pins or sliding socket rings at the “ ends,” for the purpose of connecting them together.

Another part of the invention consists in “forming beams or “ bearers for any required purpose upon the same principle as “ above named, only using plates of wrought iron, either galvanized or otherwise, instead of wood, as aforesaid, in two or “ more thicknesses, set edgeways, quite close upon each other, “ and laminated so that the fibres of the iron may cross in any “ required direction,” these beams or bearers being in some cases strengthened by ribs of T or other iron, so arranged as also to form flanges for the support of joists, or brick arches, or planking where required.

Another part of the invention consists of a novel mode of forming arches for bridges by the use of hollow iron caissons in the shape of “radial blocks,” “all pertaining to their centre or centres respectively,” these radial blocks being secured together by ribs and grooves on their surfaces, and also if necessary by bolts, catches, or other suitable means. This part of the invention also includes the use of curved iron tubes, formed of plates rivetted together, in constructing the arches of bridges. In some cases the arches of the bridges described in this Specification are to be carried to the bottom of the river or other place to be crossed, the lower portions of such arches being connected by chains or bars passing from "springing to springing." Such arches may be covered with suitable material, and the surface be provided with a pavement composed of cast-iron plates or hollow blocks of hexagonal or other convenient shape, each having "internal foot "flanges," and projections on the top to give foothold for horses. Or such pavement may be formed of "cast-iron cellular sheets," of suitable form, these sheets being in fact gratings, the interstices of which may be filled in with blocks of wood, stone, or iron, or with gravel or concrete, such filling being arranged to project above the grating and so prevent the latter from being worn away by the traffic passing over the bridge, while the filling itself can be replaced when necessary.

Another part of the invention consists in "a novel mode of "constructing traffic ways for crossing over railways, canals, "and such like places, or dangerous crossings in very crowded "thoroughfares, &c., by means of light framing," which is formed into arched ribs on the patentee's "laminated diagonal principle," either wood or iron or both being used in constructing these ribs, which may be strengthened with angle or T iron, such ribs being used in fact to form the archways of bridges, and being covered with suitable material according to the locality in which the structure is erected, access being provided thereto by steps at each end where requisite.

Another part of the invention consists of a novel mode of "crossing underneath rivers, canals, roads, &c., and forming "beneath them sub-roads or sub-aqueous traffic ways," this being effected by the employment of "an iron tube or tubes, galvanized "or otherwise, of any required dimensions" and embedded in the earth "in any convenient manner as required," the roadway being constructed "upon a segment of the bottom." Various modes of carrying out this part of the invention are described, the tubes being in some cases filled with water, and sunk down into excavations formed in the bed of a river by diving, blasting, or the use of "tubular valved plungers," and the water afterwards pumped out of such tubes. The latter are in some cases straight, and in others curved, these curved tubes causing, if a railway should pass through them, the cariages travelling thereon to be " sent through by means of their own impetus."

Another part of the invention consists in a mode of constructing foundations for the piers of bridges, of sea walls, and of other marine structures, and consists in dropping into the water blocks of granite or other suitable material having galvanized chains or chain rods attached thereto, which chains or chain rods are crossed and recrossed and connected together above the blocks as the work proceeds, and the spaces between them filled in with bags of lime, concrete, clay, stones, or other suitable substance, the whole ultimately forming a solid mass combined with a network of chains, on which a superstructure may be raised suitable for a pier, for a wall for reclaiming land from the sea, or any similar purpose. This part of the invention is described at great length, " linked blocks," either of iron or stone, being in some cases introduced into the structure, outer walls being sometimes formed around the work.

For the security of railways passing through districts in which portions of the land are liable to sink in consequence of mining operations, the patentee proposes to arrange a system of chain network under the bed or sleepers of such railways, this network being so arranged that in case of any portion of the ground so sinking the portion of railway over such ground will be supported by such network.

[Printed, 8*d*. No Drawings.]

A.D. 1853, July 4.—N° 1597.

PARRATT, George Frederick.—(*Provisional protection only.*) —" Improvements in portable bridges, rafts, or pontoons."

This invention consists " of the employment of air-tight flexible " tubes, in combination with a system of cross bars," the air-tight tubes giving buoyancy to the apparatus, and the cross bars serving as a roadway, or supports for a roadway.

[Printed, 4*d*. No Drawings.]

A.D. 1853, July 6.—N° 1613.

KENNARD, Thomas William. — " Improvements in iron " bridges."

The patentee says,—" My invention is applicable to iron " bridges constructed with a top and bottom rail united by dia-

" gonal or other ties and struts. I construct the top rail, which " has to resist compression, of two plates or flat bars placed " horizontally one above the other. I bolt or rivet two angle " irons to the upper side of the lower plate or bar, and two other " angle irons to the lower side of the upper plate or bar. I " connect these angle irons together by means of joint plates " placed at intervals, or extending the whole length of the rail. " I fixed the struts and ties by means of pins passed through " these joint plates. The extra strength given by the joint plates " to this part of the rail prevents it from being too much weakened by the holes which receive the pins."

" I construct the bottom rail or main tie of two flat bars, or of " two series of flat bars placed on edge, and one over the other. " These bars are united by joint plates, in which are holes for " receiving pins for securing the struts and ties. By placing the " two bars or the two series of bars at a distance apart, equal to " or greater than the diameter of the pins, it is not necessary " to make any holes in the bars for the reception of the pins, " which are then fixed in the joint plates only, and the weakening " of the bars is thus avoided."

[Printed, 8*d*. Drawing.]

A.D. 1853, August 3.—N° 1816.

MACINTOSH, John.—" Improvements in the construction of " bridges, viaducts, and other like structures."

This invention consists in " combining a series of bow and " spring arches into one girder or beam in such manner that each " bow or arch springs from the crowns of the two bows or " arches to which it is connected. And in constructing and " repairing arches, particularly in rivers and waterways, in place " of having piers and foundations, and springing the arches from " and supporting the arches by such piers, inverted metal arches " are used to support the arches above."

Several modes of carrying out the invention are described, in some cases the bows and strings being connected to vertical supports, the roadway resting upon the " crowns " of the bows, and the vertical supports being connected at their lower ends by inverts which lie at the bottom of the river (for example) over which the bridge passes, these arrangements enabling the bridge to be erected without forming coffer dams.

[Printed, 10*d*. Drawings.]

A.D. 1853, August 11.—N° 1871.

STEPHENSON, Henry Palfrey.—(*Provisional protection only.*)—"Improvements in the construction of suspension bridges."

This invention relates more particularly "to that description of " chain suspension bridge known as the taper chain principle, and " has for its object to render the structure more rigid, firm, and " secure."

"The first improvement relates to the transverse girders, which " are made of two strips of wrought iron having wooden filling " pieces between them. These filling pieces may be either con- " tinuous or divided into a series of cubical blocks. The wrought- " iron plates are connected together by bolts, and a girder thus " formed will be found to possess a great amount of stiffness."

The longitudinal or roadway beams are constructed in a somewhat similar manner, but the inventor proposes to make them in some cases "in a tubular form;" or they may be "gutter " shaped."

"The diagonal supporting rods are secured at their ends to the " longitudinal beams, either by passing the said ends through " wrought-iron boxes placed at the sides of the beams, or by " passing the ends through the centre of the beams, and securing " them by means of nuts placed below."

[Printed, 4*d.* No Drawings.]

A.D. 1853, August 19.—N° 1940.

DE FABECK, Frederick William Alexander.—(*Letters Patent void for want of Final Specification.*)—"The construction " of viaducts, bridges, lintels, beams, girders, and other horizontal " structures and supports."

According to this invention the viaduct or structure "is to be " composed of a double row or series of triangular parts, every " other of such triangular parts in each row or series being " inverted, so that such triangular parts may be fitted together," and the triangular parts of one row or series being arranged in inverse order to those of the other row or series, so that the apexes of the several triangular parts of each row or series may fall on or near the centres of and be firmly bolted, screwed, or otherwise fixed or fastened to the bases of the corresponding triangular prats of the other row or series.

The two rows or series of triangular parts, as well as the several triangular parts of each row, are to be fixed and fastened together by any suitable means, "according to the nature of the material "used." The invention may be modified by "substituting quadrangular parts for triangular."

[Printed, 6*d*. Drawing.]

A.D. 1853, December 3.—N° 2818.

ILIFFE, Henry Jeremiah, and NEWMAN, James.—(*Provisional protection only*.)—"Certain improvements in the construction of metallic bridges and other similar structures."

The object of this invention is so to construct metallic bridges and other structures of metal, "that great strength and resistance "is obtained with comparative lightness, and economy in labour "and material," and the inventors state that for this purpose they "propose to employ metallic tubes for every portion of the structure that will admit of this adaptation."

A viaduct is described in which the necessary piers having been erected, "of iron, wood, or masonry, longitudinal girders of elliptical or rectangular tubular section traverse the whole distance "between and rest with their ends on the piers. These girders are "in section of the form of elliptical or rectangular tubes, having "a flange or fin top and bottom, running the entire length of, "and manufactured at the same time as, the ellipse or rectangle." The inventors state that where "the size required for the girder "will admit" they propose "to roll these tubes in two parts of "the form of a semi-ellipse or half rectangle, with half fins top "and bottom," and, afterwards placing them together, to "bolt "or rivet them securely through the flanges or fins. For larger "purposes the tubes may be made of plates rivetted together." These tubes are supported laterally by transverse tubes passing at intervals through eyes made for that purpose in the fins, and are further strengthened by short tubes, each of the length of the distance between the longitudinal girders, with flanges at both ends; these short tubes are passed over the tranverse girder tube, and each is firmly secured between the longitudinal girders by being rivetted through the flanges at the ends to corresponding flanges round the eyes in the fins of the longitudinal girders. "The tranverse girders are placed alternately one "on the upper and one on the lower fin of the long girders. The "sides of the bridge consist of tubular columns rising from the

" long girders on either side, and carrying a cornice, and parapet, " and roof, constructed in the same manner as the flooring " described; and should it be required to form a double level " bridge for road and railway, the rails for the latter may be rolled " on the fins of the long girders."

"The sides of the bridge being open, a balustrade is introduced " between the columns, every member of which is also con- " structed of metal, of a tubular form, as also are all the cornices, " string courses, and mouldings used in the structure. The form " described and mode of carrying out the combination of longitu- " dinal and tranverse tubular girders may also be employed for " floors of other buildings."

[Printed, *4d.* No Drawings.]

A.D. 1853, December 23.—N° 2983.

BRITTEN, John.—(*Provisional protection only.*)—" Improve- " ments in girders, bridges, roofs, and other such like structures."

This invention " has for its object the combining in various " ways the elements of two or more distinct girders into one struc- " ture."

According to one modification of the invention two " bowstring " girders " are used, which are placed end to end, and hinged or jointed together, this hinge or joint being thus midway of the bridge or structure, and being raised much higher than the outer ends of the girders, which rest " in ball and socket joints " on the piers or supports. The two girders thus form in effect two sides of a triangle, the road being carried along them in a line about midway between the apex and the base of such triangle, suitable suspenders from those parts of the girders which are above the road sustaining the latter, which is " braced internally, so as to " secure lateral stiffness." These " bowstring girders " are each composed of a stright rod or beam combined with and united to a curved one above, there being between the two diagonal braces or cross bars.

In another modification the girders each consist of a curved bar having a straight bar above it, the two being united by diagonal braces, which also support the roadway, and a straight brace at each end of the structure, where the two bars are farthest as under.

In a third modification the two girders are each composed of two curved bars united by diagonal and other braces.

In another modification a number of curved and of straight bars are used in such a manner that the bridge or structure "may "be said to consist of ten distinct girders;" and in a further modification certain curved and a number of straight bars are so combined as to constitute "three distinct girders," but neither of the last-mentioned arrangements will be understood without the end of the drawing annexed to the Specification.

[Printed, 6*d*. Drawing.]

1854.

A.D. 1854, January 23.—N° 166. (**)

GETTY, John.—(*Letters Patent void for want of Final Specification.*)—"Improvements in the manufacture of tubular bridges "part of which improvements is applicable also to the prepara- "tion of plates for covering iron ships, for constructing boilers, "and for other analogous uses."

"This invention relates, firstly, to certain means for facilitating "the marking of the parts for the bolt-holes in the plates em- "ployed in constructing tubular bridges; and, secondly, to a "mode of determining the shape to which plates, whether em- "ployed in constructing bridges, ships, boilers, or other metal "work, are required to be cut to fit the space which they are "destined to occupy."

The inventor proposes to take a light frame somewhat larger than the plates to be used, and to stretch upon it a sheet of paper or cloth or other similar substance, suitable for receiving marks made with a piece of chalk, applied through the bolt holes, so that holes being cut in the sheet where the marks occur, a template may be formed. Besides marking the situations of the bolt holes, he draws the shape required for the plate, and cuts the paper or other material to the lines.

[Printed, 4*d*. No Drawings.]

A.D. 1854, February 25.—N° 460.

DE FABECK, Frederick William Alexander.—"The con- "struction of bridges, viaducts, lintels, beams, girders, and other "horizontal structures and supports."

According to this invention the bridge or other support "is to " be composed of a double row, series, or combination of equilateral or other triangular parts, every other or alternate one of " such triangular parts in each row, series, or combination being " inverted, so that all such triangular parts may fit together, and " form one continuous straight beam, girder, or support, and the " triangular parts forming each single row or series of triangular " parts being arranged in inverse order to those of the other row " or series, so that the two single rows or series being arranged in " lateral juxtaposition so as to form the double row, series, or " combination, the apexes of the several triangular parts of each " such single row or series shall fall or be placed on or near to the " centres of and be firmly bolted, screwed, or otherwise fixed or " fastened to the basis of the corresponding triangular parts in " the other single row or series."

Various modes of connecting the parts of the structure together may be adopted, and in cases where great strength is not required quadrangular parts may be substituted for triangular parts.

[Printed, 6*d*. Drawing.]

A.D. 1854, March 24.—N° 690.

MONTGOMERY, Richard.—" A new and useful improvement " in corrugated metals, and in machinery for producing the " same."

The invention consists, firstly, " in making plates of metal " applicable to steam boilers and other purposes, plain on their " margins and corrugated within, the corrugated part being thinner " than the margin. It also consists of rolls of a peculiar construction for producing these corrugated plates from plain sheets " or plates, and for bending and arching them when necessary."

And, secondly, " in machinery for corrugating plates of metal " into beams suitable for houses, bridges, ships, &c., in which " machinery the plate is passed a number of times through a pair " of grooved rolls and a stationary crimping die, by which the " folds of the beam are gradually brought to the proper depth, " without endangering rupture of the metal, which is unavoidable " when the corrugation of folds of any considerable depth is " effected by rollers alone."

[Printed, 1*s*. Drawings.]

A.D. 1854, April 11.—N° 855. (* *)

JAMES, William Henry.—" Improvements in marine and " other structures."

1. These improvements are certain variations of, additions to, and new applications of a method of constructing cellular plates and vessels, for which a grant of Letters Patent was made July 25th, A.D. 1845, and which are also referred to in another grant of Letters Patent, dated September 3rd, A.D. 1852. In the present Specification a method is detailed of " uniting metallic plates for the for- " mation and manufacture of cellular plates by rolling the plates " with a series of parallel projecting ribs upon one side of the " plate, which ribs are then grooved longitudinally in a dovetail " shape by planing machines to allow their ribbed surfaces when " placed opposite to be firmly united by a series of corresponding " dovetail bars, partitions, and tenons to slide therein." The variations mainly consist in binding, by similar dovetailed partitions, any number of plates placed one above another, having corresponding ribs formed on both surfaces by a very powerful stamping machine and dies. The patentee describes the method of forming the cellular plates and hollow partitions, and of strengthening plates.

2. To avoid objections that might be urged against stamping machines of such power being employed in consequence of the concussion to neighbouring buildings from the falling of such heavy weights on a bed plate, he describes two varieties of " an " aërial antagonistic stamping machine having a double counter- " acting movement " to neutralize the concussion.

3. He also applies the cellular plates in the construction of hulls, compartments, beams, rafters, hollow masts, boats, barges, pontoons, and rafts; also in floors, roofs, side walls, beams, rafters, doors, roadways, bridges, viaducts, and tanks, railways, sides, beds, and roofs of carriages.

[Printed, 6*d*. No Drawings.]

A.D. 1854, May 16.—N° 1092.

BAKER, James Philip.—" Improvements in the construction " of railway and other bridges, and in the method of lifting the " same after sinking."

This invention relates, firstly, to so constructing the foundations of bridges as to admit of easy access being obtained thereto for the purpose of lifting such bridges after sinking, the foundations being provided with projecting plates of metal, which serve as supports for lifting jacks or other lifting apparatus, when it is necessary to lift the superstructure of the bridge. The invention is described more particularly as applied to a bridge passing over a railway, and constructed with trestles and girders. The projecting plates mentioned above sustain projecting blocks of timber or other material, and on these latter rest the lower ends of the trestles, the upper ends of which carry the girders, and these last support suitable timbers forming the platform or roadway. The plates and blocks on which the trestles and girders rest project from the lower portions of abutment walls or piers of masonry, but the effect of these arrangements is, that the platforms, girders, and parts in connection therewith, can be raised without interfering with such masonry. The various projecting blocks and plates are surrounded by "retaining walls," carrying wooden frames, on which rest planks capable of being easily removed when access to the foundation of the bridge is required.

Another part of the invention consists in constructing bridges "with the platform and girders overhanging or extending beyond "the abutment walls or piers and trestles, and with walls to "support such overhanging parts, and prevent the ballast or other "rubbish falling in between the girders when such bridges are "being lifted after sinking."

The invention also includes "the construction of the abutment "walls or piers of railway and other bridges with wall plates "built thereon, for the purpose of receiving and supporting the "platforms of such bridges."

The parapet of a bridge of this kind does not extend quite to the walls supporting the overhanging parts mentioned above, and is "free of the girders and platform." And in the case of a bridge crossing a railway a guard of sheet iron is placed in front of the trestles to prevent hot coke from the engine-box from igniting such trestles when coated with gas tar or other inflammable matter.

[Printed, 10*d*. Drawing.]

A.D. 1854, June 20.—N° 1350.

BRAITHWAITE, FREDERICK.—(*Provisional protection only.*)—"Improvements in constructing suspension bridges, roofs, and "coverings."

This invention is thus defined :—

" My invention consists in the novel application of wire rope, " hemp, flax, or cotton ropes, canvass or other textile material, " iron chains and iron links or bars of whatever length, to the construction of suspension bridges, roofs, and coverings, so " that I effectually avail myself of the mechanical and tensile " strength of all such materials ; and this I effect by directly " covering the surface of such materials, longitudinally or trans- " versely, with any known materials ordinarily used for that pur- " pose ; in fact, my platform, roof, or roadway, is directly on the " chain."

" My second improvement consists in introducing a second set " of suspension chains, placed one above another, so as to con- " nect my guard or handrail, but by which arrangement my " handrails become auxiliary suspending rods to the lower or " principal suspending chain, on which the platform is placed."

[Printed, *4d.* No Drawings.]

A.D. 1854, June 22.—N° 1379. (* *)

FARRELL, Isaac.—The manufacture and use (for floors, roofs, walls, bridges, and girders) of tiles or slabs designed to obtain mutual support when fixed. Each tile has a " rabbated button," which "may be round or square, or any other geometrical figure," raised on or attached to the middle of it at the back, and has its four corners so cut off and rebated, that each is equal in size and form to one-fourth of the button ; and the tiles are to be so laid, that the angles of four in an upper series shall exactly receive the button in the centre of one in a lower series. There are indents on the backs of the tiles to admit of a bed of mortar.

Several varieties of form are shown and described by the inventor, who proposes to build walls and bridges of these tiles laid edgeways ; also a compound beam formed of two thicknesses of slate slabs, " with a wedge-shaped button bolted to the centre of " each," and the ends of the slabs cut obliquely, so as to correspond with and embrace the splay of the wedge. All the bolts pass through an iron plate, or two iron plates, placed between the slabs of slate.

[Printed, *1s.* Drawings.]

A.D. 1854, June 28.—N° 1421.

BRUNLEES, James.—" Improvements in drawbridges appli-" cable to rail and other roadways."

This invention consists "in so constructing the roadways of " bridges that they shall be capable of being lowered below the " general level, and drawn backward beneath the surface thereof."

One end of the drawbridge rests, when in position for being used, upon eccentrics fixed upon a shaft mounted in suitable bearings below it. Upon this shaft there is a worm wheel, and by means of a worm and a winch handle on the axis thereof, the shaft, with the eccentrics, may be turned so as to lower that end of the bridge until certain rollers or wheels with which the bridge is furnished rest upon an arrangement of rails forming an inclined plane. To the lower side of the drawbridge is fixed a rack, and by means of a pinion in geer therewith, and actuated through the medium of certain spur wheels and another winch handle, the drawbridge is moved down the inclined plane, so as to leave a free passage as requisite. The bridge is raised to its first position by an operation the reverse of that described above, and is kept in position, when in use, by a notched wheel and a catch, which prevent the eccentrics from turning when not required to do so, and a bolt passing through certain plates which are arranged at one end of the bridge.

The details of the invention may be variously modified.

[Printed, 10*d*. Drawing.]

A.D. 1854, July 14.—N° 1550.

McGAFFIN, John.—" Improvements in the construction of " iron bridges."

This invention consists in constructing iron bridges or roofs " by rivetting or screw-bolting corrugated plate or sheet iron " together, either straight or in an elliptic form, an arc, or seg-" ment of a circle, and placing the sheets so jointed together of " the required width across the place to be bridged, and several " of these curved or straight sets of sheets are to be placed over " each other at distances according to the span and the thickness " of the plates or sheets used." The sheets may be arranged with spaces between them, and pieces of wood be inserted in such spaces, or metal bearers in place of wood; or the sheets may be placed close together. The bridge may be strengthened by tension rods extending from the piers, and corrugated angle or T-iron laid across it. "The space or spaces between the piers "and the rise of the bridge may be filled up with corrugated iron "pipes or cylinders laid in concrete or other material. These "pipes may also be bolted or riveted together; they extend across "the bridge in layers so as to form a foundation for the carriage "way. The corrugated pipes consist of corrugated iron plates, "or sheets of iron bent into a circle in one or more pieces, and "riveted or bolted together to any length required."

"The construction of roofs upon this principle is in substance "the same as for bridges."

[Printed, 10*d*. Drawing.]

A.D. 1854, July 28.—Nº 1666.

MORTON, **Francis**. — "Certain improvements applicable to "girders or rafters to be used in the construction of roofs, "bridges, buildings, and other erections."

The object of this invention is so to combine and arrange the parts of girders, rafters, or "principals," that "great facility of "erection and transport may be obtained."

"The rafters or girders are composed of sets or series of pieces "bolted together, so that the complete rafter or girder may not "only be capable of sustaining itself when all the parts are "united, but of resisting considerable pressure. The centre or "middle part of the girder is formed of either single or double "T iron, having flanges at top and bottom for the purpose of "increasing the strength of the pieces. The ends are made to "abut, and the pieces are connected together by side plates which "lie in the grooves of the centre pieces, and are secured in their "places by bolts, which pass through the three thicknesses."

Although for girders of great length it is preferred to have flanges both at top and bottom, yet where great lightness is required a flange at the top only may be used, and in some cases also it may be convenient to employ, instead of "single pieces of "double T iron," two pieces of double angle iron, bolted or otherwise fastened together. "The side pieces may be provided "with an angle or rim on one side, thereby greatly adding to the "strength with a small addition to the weight; and when the "side pieces are made of cast iron an additional thickness may "be given round the bolt hole on one side, to compensate for the

" diminished quantity of solid metal in drilling the hole for the " bolt."

" The ends of a girder or rafter formed in this manner may " be inserted in a socket or shoe secured to the piers or walls " of the building or other erection, and when the parts of the " girder are made of wrought iron, shoes to receive the ends of " the wooden purlins or lateral braces must be bolted or otherwise " secured to the centre pieces. This will give great rigidity to " the whole structure, and the covering of the roof may be " secured to the wooden purlins in any of the known ways." Cast or wrought iron, rolled iron, or wood, or a combination of any or of all of these materials may be used in forming these rafters or girders. Different modifications of the invention are described.

[Printed, 10*d*. Drawing.]

A.D. 1854, September 18.—N° 2011.

SIMPSON, WILLIAM.—(*Provisional protection only.*)—" An " improvement or improvements in beams or girders for bridges " and other structures."

The "essential novelty" of this invention consists " in the " combination of a triangular beam with a tubular beam or " girder," and a method of connecting the two together. The triangular beam or truss sustains the tubular beam or girder, the lower portion of the triangular beam being adjustable in length by an arrangement of " screw boxes," and certain " vertical sup- " ports," through the medium of which the tubular girder is sustained, being adjustable by " screw nuts."

[Printed, 6*d*. Drawing.]

A.D. 1854, October 2.—N° 2105.

BELLFORD, AUGUSTE EDOUARD LORADOUX.—(*A communication.*)—(*Provisional protection only.*)—" Improvements in sus- " pended purchases."

This invention consists " in a system of raising, conveying, and " lowering heavy bodies employed in the construction of bridges " and such like structures over streams or ravines, by means of " suitable cables, tackles, and apparatus, stretched across from " point to point, and forming a fixed track over or upon which " suitable carriages and adjusting apparatus can traverse, for the

" purpose of transporting and depositing the material required to " be so raised, conveyed, or lowered."

[Printed, 4*d*. No Drawings.]

A.D. 1854, December 11.—N° 2603.

STEVENS, Nehemiah Edward.—(*Provisional protection only.*) —" A mode of joining or connecting together blocks of stone and " other building materials."

This invention " consists in connecting blocks of stone, wood, " bricks, or other materials by means of a groove and tongue, " circular or of any other form; and although applicable for " general purposes is specially so for arches and culverts." The inventor considers that by this method of forming arches centering would be avoided, and mortar or cement rendered unnecessary, except, perhaps, for pointing the joints. " The invention is " peculiarly applicable to Hutchinson's patent indurated and " impervious stone."

[Printed, 4*d*. No Drawings.]

A.D. 1854, December 21.—N° 2692. (* *)

BERTRAM, William.—" Improvements in the manufacture of " iron ships, steam, and other boilers, bridges, and other struc- " tures where numerous sheets of iron are used."

In the construction of boilers, bridges, and ships the sheets of iron have been united by rivets, by which the frame is weakened from the metal being cut away, and the weight of material increased from overlapping at the edges. The present improvement lies in forming the sheets of iron properly at their edges for being welded together, with ribs thereon running transversely or longitudinally, to be used instead of angle iron or ribs. In place of being hammered, the parts at a welding heat may be pressed together by rollers.

In ship building the keel, kelson, cut-water, and stern post may be welded into one piece of iron. A portable furnace mounted on a frame and moved on a rail, and steam hammers are described as the operating apparatus, the description of this part of the invention being accompanied by explanatory drawings, on a large scale.

[Printed, 1*s*. 10*d*. Drawings.]

1855.

A.D. 1855, February 23.—N° 407.

THOMPSON, Nathan, jun.—" Improvements in constructing " life boats."

The object of this invention is to construct life boats in such manner that they may be more readily folded and packed for carriage than those made on the ordinary system. According to one modification of the invention the sides of the boat are formed of rigid material, but in sections, these sections being connected by hinges, and the end portions of the sides being also hinged together to form the ends of the boat, these hinged parts being covered with waterproof canvas, india-rubber, or sole leather, such covering being extended, if desirable, over a considerable portion of the boat. The woodwork forming the sides of the boat is hollow, chambers being thus formed, which may be filled with air or cork to increase the buoyancy of the boat. The sides of the boat are connected to a " longitudinal brace or kelson, secured to the end " hinges in such manner that the sides may slide lengthwise of " the said brace or kelson," and to the lower portion of the latter is hinged a solid floor, which is in two parts, these parts rising up along the brace or kelson when the boat is closed, and falling down perpendicular to the kelson, or nearly so, when the boat is opened out.

" Inasmuch as the boat is longer when closed than when open, " it is necessary to connect the end joint with slots or longitudinal " openings, the joints having a pin or slider to run in them, so as " to have the effect of elongating the centre brace or kelson, and " shortening the same, according to the exigencies of the occa- " sion." " The position of the slider is not material; it may be " at either end; or they may be in the hinges themselves in the " sides of the boat, or only slides only may be used, the other end " fixed not to slide," and when the boat is expanded the sides are kept apart by cross braces which open like gates from the longitudinal brace or kelson, and serve the triple purpose of a brace to hold open the sides of the boat, to hold down the bottom, and to support seats for oarsmen. Metallic braces furnished with hooks and eyes may also be used to stiffen the boat if necessary. On the top of each cross brace is an iron fixture, with a slot or opening to take a pin or bolt placed in a groove in the side of the bolt, " so that in swinging the cross braces open, the sides are fastened " instantly," the bottom being also secured in position by " steady " pins " projecting from a flange passing along the lower portion of the sides of the boat.

According to other modifications of the invention the sides, instead of being in sections and hinged together, are single, " of " springy wood," and without air chambers, such chambers being in some cases formed in the longitudinal brace or kelson, or the sides of the boat may, if preferred, be of metal instead of wood.

This boat may also be so modified as to serve as a "gun and " military bridge boat," in this case a solid upper flooring being hinged to the upper part of the kelson, in addition to the lower flooring already mentioned, such upper flooring, on the boat being expanded, resting on the cross braces and sides of the vessel, thus forming a deck or platform. In this modification the sides of the boat are not curved in the manner usual in boats, but so contrived that when the vessel is expanded the form of the whole is that of a diamond or lozenge, a number of these vessels being then placed close together to constitute a bridge.

[Printed, 1*s*. Drawing.]

A.D. 1855, March 8.—N° 526. (* *)

GERARD, John.—(*Provisional protection only.*)—The invention consists " of portable floating vessels with moveable water-tight " decks, sides, ends, and bottoms, and sliding or folding frames, " platforms, stays, and supports, the whole being made and fitted " together in sections composed of and separating into duplicate " parts, designed for forming a portable extending pier, bridge, or " platform for facilitating the embarking and disembarking passengers, troops, cattle, stores, or merchandize, or for effecting " a passage or forming a roadway across water; the said sections " and duplicate parts being also designed and intended for forming " works or buildings of defence, shelter, or stores on land, and " also adapted for forming waggons or other vehicles. Each " vessel, structure, or vehicle can be fitted together or separated " with facility and dispatch, and packed together so as to occupy " a comparatively small space for shipment or removal when not " in use."

[Printed, 3*d*. No Drawings.]

A.D. 1855, May 4.—N° 999.

HAMILTON, John, junior.—" Improvements in the construction " of iron girders."

This invention relates to the construction of girders of corrugated iron by fastening together sheets of corrugated iron (galvanized or not) " by rivetting or screw bolting to the extent of the length " and width of the intended girder." One, two, or more such series of sheets may be used in constructing the upper part of a girder, and where two or more are employed " they are to be " fastened together and kept at a distance apart and parallel to " each other by transverse partitions of wood, or of cast or wrought " iron, with undulations to correspond with and fit the corruga- " tions of the corrugated sheets; and where the distance apart of " two sets of parallel sheets of corrugated iron is considerable, " vertical partitions of corrugated sheet iron are used. Such " partitions may be affixed by means of corrugated angle iron to " the horizontal plates of corrugated sheet iron, and such vertical " transverse partitions of corrugated sheet iron are also used as " upright props when combining the upper part of a girder with " the lower part of a girder, whether such lower part consists of " corrugated sheets of iron or plain sheets of iron; and in addi- " tion to such vertical partitions or props of corrugated sheet iron " diagonal sheets of sheet iron, either wrought or cast, and either " corrugated or plain, are used."

A girder of considerable strength, and yet composed of comparatively light sheets of iron, may be formed by laying two or more corrugated sheets together " as if they were one plate in " thickness."

Although the Specification of this invention does not distinctly mention that these girders are meant for use in the construction of bridges, they are obviously applicable to that purpose, and are shown as being so applied in a Drawing annexed to the Specification.

[Printed, 6*d*. Drawing.]

A.D. 1855, May 26.—N° 1203.

AVERY, John.—(*A communication.*)—" Improvements in appa- " ratus for conveying heavy weights for bridge building and other " purposes."

According to this invention a "tower" composed of wood or other material is erected on each side of the river or place to be crossed by the bridge, and a cable is passed across from the top of one of these towers to the top of the other, the ends of this cable being carried down behind the towers and firmly fixed to the ground. The cable thus forms a "fixed track," upon which is mounted a truck or carriage, furnished with wheels and capable of travelling to and fro on the cable. From the middle of this carriage are suspended "tackle blocks," provided with a rope which passes round the sheaves of the blocks in the usual manner, the fall end of this rope proceeding from the upper block to one of the banks of the river or place to be crossed, when it is operated upon by workmen when necessary. The truck is also provided with blocks and ropes passing therefrom to each bank of the river, by which means it may be drawn into various positions on the cable.

In using the apparatus the truck is first drawn to one side of the river or place to be crossed, over a stone (for example) which is to be moved thence to a position in the bed of the river where a pier is being erected. The stone is connected to the lower block by ordinary means, and then raised by pulling at the block rope until the lower block arrives almost in contact with the upper one, when certain clutches in the lower take hold of projections on the upper block, and secure the two together. This takes the strain off the block rope, and then one of the ropes which serve to control the movement of the truck is slackened, and the truck, with the stone hanging beneath it, will pass for some distance along the cable by its own gravity, the cable not being quite tight, and consequently forming an incline at the parts next the towers. When the truck has arrived over the spot at which the stone is required its motion is stopped, and the clutches which are locking the tackle blocks together are disengaged by again pulling at the block rope and slightly raising the lower block, which brings into action a "cap piece" which acts upon certain rods connected to the clutches, and then by slackening the block rope the stone is allowed to descend to the required point. If desirable, instead of keeping the truck stationary while the stone is being raised and lowered, such raising and lowering may be effected while the truck is in motion.

Different modifications of the invention are described, in some cases several cables being used, each having a separate truck, but the tackle blocks suspended from them being so connected by certain beams as all to be capable of acting simultaneously upon one stone. These beams are termed "equalizing beams," their use being to equalize the strain upon the different cables; and the frame of the truck is in all cases made "flexible," the wheels being three in number and the centre wheel larger than the others, by which arrangements the truck adapts itself to the curvature of the suspended cable. The apparatus may be employed in moving the parts for the superstructure of the bridge after the piers are built, and also in the erection of other structures.

[Printed, 10*d*. Drawing.]

A.D. 1855, July 4.—N° 1501.

TABOURIN, Georges Antoine.—" A new system of metallic " arch, proper for the construction of bridges, arcades, vaults, " roofs, and all other such purposes."

The patentee says:—" The fractional arches of my system are " generally made of cast iron, united together by under lugs " jointed together somewhat like the head of a pair of compasses " or the joint of a folding foot rule; a central joint bolt is passed " through the under lugs. Each beam or girder, forming a complete arch, is composed of as many fractional arches as may be " required to form the total length of the whole beam or arch, " the length of the said fractional beam or arch having been previously determined. The beams or girders just mentioned are " laid up in parallel lines at a suitable distance from each other, " so as to form bridges, vaults, or arcades of the required breadth; " they are then united with each other by single bolts passing " through the centre of the lugs, which are separated by tubular " transoms traversed by the same bolts. The lugs or compasses' " heads forming the hinged joints of the arches are situated at " the lower end of each of the said arches, whilst the upper part " of both their ends forms a plane or propping face, so disposed " that the adjoining propping faces of two successive arches may " bear on each other, in order to transmit on the butment the " jutting out or force which would tend to bend the vault down."

The floor of the bridge may be formed of boards covered with concrete and bitumen, or of iron plates, the latter acting as stays or transoms. The invention may be applied in the formation of " roofs of great length."

[Printed, 1*s*. Drawings.]

A.D. 1855, July 21.—N° 1655.

PITTAR, Samuel John. — (*Partly a communication.*) — " Im-" provements in the construction of bridges."

This invention consists in combining several systems of diagonal bracings with posts or perpendiculars in such manner that a weight coming on one of the systems of which a truss-formed bridge consists when constructed according to this invention, is not only transferred over that one system, but over and through the whole of the systems before it is brought to the piers. For this purpose a number of parallel posts are employed, connected by suitable bars and tension rods, so as to constitute the several " systems " mentioned.

The details of the invention are set forth at some length, but the essence of the invention is the combining of different systems of " triangular bracings " so that " a weight coming on one of the " 'systems' of the 'truss' is not only carried over one or more " other 'systems' before it is carried back to the 'abutment,' but " the foot of the post of each triangle shall be capable of setting " vertically and moving to the side, so that the 'tension rods' of " each 'system' of the triangular bracing will be strained equally " when the bridge settles under a superincumbent weight."

[Printed, 1*s*. 8*d*. Drawings.]

A.D. 1855, September 15.—N° 2081.

WOHLGEMUTH, Paul Frederick. — " The construction of " bridges."

This invention is thus set forth :—" Pontoon shaped iron boats, " 200 feet long (more or less) by 70 feet wide (more or less) " and 40 feet deep (more or less), having concave sides and bot-" toms, hollow iron stanchions 30 feet apart from each other, " with iron compartments between made to open from the top on " centres, and having bulwarks 20 feet high (more or less.) Two " or more of these boats may be braced together with diagonal " tie bars, six feet span between each if a greater breadth than " one might be required, whilst the number of iron boats required " to complete the bridge would be determined by its length ; the " bottoms of the boats to be firmly tied together by a circular " concave iron frame, keeping under water a number of hollow " iron caissons or cylinders, the size and length of which must be " regulated by the weight it will have to bear, and at 50 feet

" (more or less) from the surface of the water. One or more " piers, 100 feet high (more or less), can be erected on the platform, and braced together by diagonal tie bars, forming frames " on either side to support the top and sides of piers, themselves being the starting point of the arches, which may be 150 " feet to 200 feet span (more or less), according to circumstances, " in which latter case it may be advisable to have a circular tie " bar opposed in the reverse position to the arches, and supporting it by perpendicular tie bars attached thereto. The platform " to be of corrugated iron and wood firmly bolted together. " Every 5th, 10th, or 15th pontoon, as it may be required, would " have attached to it by a ring an iron chain, the extremity of " which would be attached to another ring, firmly let into a large " stone, and sunk or made fast at the bottom of the sea. Every " pontoon is to be protected on all sides from the violence of the " sea and ships coming against them by concave iron bars, superfixed to one another and acting upon springs. The whole of " the bridge is so constructed as to form such a surface as to " be sufficient to act as a floating breakwater in the roughest " sea."

" On the platform may be placed rails for railways, and every " other arch on either side may be illuminated by gas, electricity, " or any other advantageous mode." "The rise and fall of the " sea may be regulated by water let into the iron compartments, " and let out again by engines or other mechanical means. A " raised platform would be erected to meet it from the shore."

The sunk caissons must be so arranged as to " allow the ships " of the heaviest burthen to pass in the roughest weather, and to " clear the arches of the bridge."

[Printed, 4d. No Drawings.]

A.D. 1855, October 17.—N° 2323.

BESSEMER, Henry.—" Improvements in metal beams, girders, " and tension bars used in the construction of roofs, floors, and " other parts of buildings, and in the construction of viaducts " and suspension and other bridges."

The object of this invention is " to give the required degree of " cohesive strength and rigidity to beams, girders, and tension " rods with a less weight of metal than heretofore used in beams " of equal strength." In describing the details of the invention the patentee says :—" I put refined or pig iron into a puddling

" furnace, and there work it in the usual way, but leave off the " operation of puddling before the whole of the carbonaceous " matters are driven off. About one per cent. of carbon should " be retained, or as much as by its combination with iron consti- " tutes steel; or the metal may be puddled until the whole of the " carbon is driven off, and the powdery iron resulting from this " process may be afterwards converted into steel by cementation; " or the refined or pig iron may be otherwise decarbonized and " reduced to the state of steel; in either of which cases the metal " is brought to a complete state of fusion in pots similar to those " used in the melting of steel. When, however, great toughness " is desired, I prefer to use scrap iron, decarbonized iron, or mal- " leable iron, which I put into the pots alone, or mixed with " charcoal or other carbonaceous matters. When used alone the " product will be cast malleable iron, but when mixed with car- " bonaceous matters a partial cementing of the iron will take " place and a 'mild' or soft steel will result, peculiarly well " adapted to resist heavy shocks or sudden strains. The metal " having been melted I proceed to cast it into beams or girders " of the desired form in sand or loam moulds, or otherwise, " and which are afterwards annealed; but when beams, girders, " or tension bars are required of great length, or are required to " be very light in proportion to their dimensions, I cast the fluid " metal in iron ingot moulds, and afterwards roll out the ingot " of cast metal between rolls, until the ingot is reduced to the " desired thickness; the ingots so cast are to be made of such a " form as will correspond with the intended plate or bar of " rolled metal. When a fish-bellied beam is required the " ingot should be made straight at one edge and curved at the " other, but of much less length, and consequently much thicker " than the finished plate is to be."

Different forms of ingot, suitable for being rolled into beams or girders of different shapes, are described with the aid of a drawing annexed to the Specification, some of such beams or girders having flanges both at top and bottom, and others being of " a T shape," and where these beams or girders are to be constructed of a number of ingots rolled into the form of plates and rivetted together, those parts of the plates through which the rivet holes and rivets pass are made thicker than the rest, so as to avoid weakening the plates at those parts. For facilitating the construction of hollow beams without the use of angle irons the patentee, where practicable, rolls the plates so as to extend the entire length of the beam, transverse joints being thus avoided and a thinner plate sufficing. Plates may, however, be rolled "with angles or webs formed thereon." And for beams of large size a number of plates may be arranged so that the thick edges of the plates form the vertical joints of the beam, these edges not overlapping, but the plates being united by other narrow plates on each side, covering the joints, and the whole united by rivetting. Tension bars with enlarged heads may also be formed by rolling, the ends of the ingots being enlarged from which such bars are to be made.

[Printed, 10*d.* Drawing.]

A.D. 1855, November 26.—N° 2659. (* *)

COIGNET, FRANÇOIS.—" Certain improvements in the use and " preparation of plastic materials or compositions to be used as " artificial stone, or as concrete or cement for building and other " purposes."

This invention relates to the production of artificial stone, concrete, or cement from various combinations of sands, gravels, broken flint, broken stone, burnt or unburnt clayey soil, cinders and coal refuse, scoria, wood ash, the residue and dross of metallurgical works, and puzzolanas, with unctuous or hydraulic chalk or lime, and fine sand. These materials may be combined in different modes. For example sand, grits, metals, and broken stones may be combined with clayey (but unburnt) soil and ordinary or hydraulic lime; or sands, grits, metals, and broken stones, cinders and scoriæ of coals and metals, burnt clayey earth, and puzzolana, may be used with lime; or very fine sand, cinders and scoriæ of coals or metals, burnt clayey soil, puzzolana, and lime may be used in combination with marly or clayey but burnt sands. The lime is slaked before being mixed with the other substances, water being also added in the process of mixing when necessary, such mixing being effected by machinery.

By the use of moulds the concrete thus formed may be brought into use for various purposes. Thus blocks may be made which will serve instead of stones or bricks for building purposes, and may be used in the construction of bridges, as well as other erections; while in other cases the concrete may be applied to the surfaces of walls erected of ordinary materials, moulds being first fixed to such walls, and the concrete being placed in such moulds, the latter being removed when the concrete is sufficiently hardened, which hardening may be effected by compression, or by leaving the mould in position for a certain time. Floors may also be formed of this concrete, by arranging in the first place a number of iron "planks" or rods, crossing each other, and extending from one wall to another of the building in which the floor is required, and then placing below these planks or rods a false or temporary flooring of timber on which the concrete is poured, the temporary flooring being removed when the concrete has become hard, and the floor then consisting of such concrete bound together by the rods or planks; which may, however, be strengthened by "beams" if necessary.

The concrete may also be applied in the formation of roofs, vaults, and wall in general. Also in the construction of aqueducts, and "any hydraulic works whatever;" "mass work" or foundations for machinery; pavements, and "floors covering the "road;" as well as "masonry works" for railways, and a variety of other purposes.

In certain cases, such as the construction of roofs and floorings, the surface of the concrete is "washed" with a solution of biphosphate of lime, which hardens such surface, and destroys the alkalinity of the lime, and thus allows of the application to such surfaces of paints "having a fat or resinous basis." The rods or planks used in the construction of floors may be used for sustaining the concrete in other cases.

[Printed, 4*d*. No Drawings.]

1856.

A.D. 1856, January 11.—N° 84.

CLARKSON, THOMAS CHARLES.—"A combination of certain "materials for forming and making improvements in ship and "other pumps' tubes, and which is also applicable for ship, "carriage, and other building purposes and parts thereof."

As regards pumps, this invention consists in using, in the construction thereof, alternate layers of thin wood, from one-eighth to one-half of an inch in thickness, canvas, prepared leather, and sheet cork, these layers being united by means of india-rubber, marine glue, or other adhesive substances.

The patentee states that these materials may be used "in part "or whole," as circumstances may require, and that one layer of canvas or leather is always placed between one or two layers of wood or cork, except in cases in which the material is required to be very thin, in which cases the wood or cork is placed between two layers of canvas or leather. "The cork material is always "applied in the working part of the pump, to form a bed or "cushion for the metal or glass chamber where the bucket or "plunger works, to give a smooth and elastic action, to avoid "undue friction."

The pumps may be of square, "oblong square," or triangular form, and so constructed as to act either as force or delivery pumps. They may be of such shape as to "fit the section of a "ship or any vessel," and be provided with a slide or opening which will allow of the chamber being cleansed and repaired "when at sea or otherwise." The bucket or plunger is composed of two thin square plates of metal or wood, with cork or leather between them, which latter can be moved outwards as the working edge wears, and a lip or flap of soft material is fixed on the top of the bucket to prevent the access of dirt to the chamber, and to aid in the production of a vacuum below the bucket in case of any dirt working upwards from below between such bucket and the said face of the chamber, or in case of the wear and tear of the bucket causing irregularities in its surface.

Layers of material such as mentioned above may be used in the formation of "compass timbers and other spars, tubes, &c. "for ship, carriage, or other building purposes, or parts thereof," and to give extra strength to such articles as require it these layers of material may be placed on the outside of a sheet of metal, and so applied as to leave "a square opening available for "ventilation of the ship, also applicable for a pump to be worked "by steam or hand power." In the formation of tubes and shoots to be attached to the pumps for conveying water or other liquids under or above ground, thin wood or sheet cork is used, of from one-eighth to one-fourth of an inch in thickness, two sheets of this material having between them canvas or prepared leather, this "thickness and make" being applicable for flooring, roofing, boats, gun carriages, waggons, cases, and other articles.

Various adaptations of the invention are described by reference to a drawing annexed to the Specification, and the combination of the materials with an internal metal frame is mentioned as being applicable not only for pumps, large spars, and other articles, but also in the construction of tubular bridges. The patentee mentions that in cases in which one thickness only of wood is used, with one layer of canvas, the canvas is always placed " internally," which, he states, will, in the construction of life and other boats, render the structure much stronger than if the canvas were to be placed externally. He also states that in order to prevent imitation of his invention " by metal pumps," he claims " the shape of square, oblong square, or triangle " pumps in cast or wrought metal, with or without the elastic " bed for the metal or glass chamber."

[Printed, 10*d*. Drawing.]

A.D. 1856, February 14.—N° 380.

McFARLANE, WALTER. — " Improvements in building and " structural works and fittings in metal."

This invention relates to " an improved system or mode of " adapting cast iron for building and structural purposes, " whereby houses and erections of various kinds may be built " and firmly connected in their details without the slightest aid " from screws, bolts, nails, or other loose binding apparatus," the invention being also applicable in the formation of hinges, latches, fastenings, plugs, valves, gratings, and other articles.

The essential feature of the invention is the connecting of the parts of the building or article together by means of " dovetail " mortises and tenons, or dovetail grooves and feathers." These mortises and tenons, or grooves and feathers, " may of course be " respectively formed on such parts or details as may be found " most convenient or suitable in practice," and when the parts are placed together the junctions may be made tight and sound by means of lead, putty, rust cement, or other material according to circumstances.

These arrangements are applicable to bridges, and also to tunnels, and the internal lining of mine shafts, in the two last cases the metal, in the form of plates, " being placed in position " as the excavation goes on." An archway suitable for a bridge or other erection is described as being composed of plates, the feathers of which are placed in grooves formed in upright pillars, one or more of the latter standing at each side of the arch.

The details of the invention are described at some length, and include the forming of fastenings and other moveable details in or upon cast-iron articles or apparatus, " by first casting the " moveable detail separately, and then placing it in position in a " second mould formed for casting the piece to which the detail " is to be connected, the working surfaces of the piece being " formed by or cast upon the working surfaces of the moveable " detail, the latter being first coated with a suitable preparation " to keep the parts free ; " and also a mode of forming pipes and ducts for water, gas, or steam, " with side branches for receiving " other connections," by the employment in casting them of " green sand cores and hollow branch patterns of the actual shape " of the required branch."

[Printed, 1*s*. Drawings.]

A.D. 1856, February 25.—N° 480. (* *)

CLAUS, Charles Frederick. — " Improvements in metal " shipbuilding, applicable also to steam boilers, bridges, and other " structures in which metal plates are used."

The " invention consists in the production of extended surfaces " of metal by uniting a number of bars or strips in such manner " that they are interlaced or platted together. In order to obtain " greater firmness, I notch the said bars or strips, and so arrange " them that projecting parts " fit " into corresponding recesses ; " and I round the lapping edges in order to gain a smooth face. I " also weld the several portions, or apply tin and lead," or other metals, so as to solder the whole together.

[Printed, 6*d*. Drawing.]

A.D. 1856, March 22.—N° 684.

BARLOW, William Henry. —" Improvements in covering " and constructing bridges, viaducts, floors, and other structures " of a like nature when iron is used."

This invention relates to the construction of bridges, and structures of a like nature, " when iron is used." For these purposes " corrugated structures of iron are employed in place of wood

" planking, and also in forming floor girders without other beams " or girders, and the combination of the parts is such that the " horizontal parts which resist by tension do not, as heretofore " in beams, come under the horizontal parts which resist com- " pression. By these means great stiffness and strength are " obtained."

In carrying out these improvements the patentee either uses iron rolled into the form of troughs, with flanches on either side, or builds such trough-like structures by combining plain sheets or various forms of angle iron together; and the corrugated covering to the beams or girders of a bridge or other like structure is produced by combining a series of such trough-like structures side by side; or the whole covering of a bridge, viaduct, or other like structure may be formed " without the use of other " beams or girders, by obtaining the requisite stability by the " combined corrugated structure alone." The invention may be variously modified.

[Printed, 6*d*. Drawing.]

A.D. 1856, July 19.—N° 1710.

YOUNG, Edward William.—" Improvements in the con- " struction of bridges."

According to this invention " the platform or roadway of a " bridge is suspended from chains, which do not hang in curves, " as in ordinary suspension bridges, but descend in straight in- " clined lines from the points of suspension to the platform of " the bridge. From these chains, and at intervals between the " points of their suspension and their connections with the plat- " form or roadway, suspending rods descend in inclined or " diagonal directions to the platform or roadway of the bridge, " and the chains are supported at intervals by props or uprights, " which at their lower ends are supported by the platform or " roadway at points near where the lower ends of the suspending " rods from the chains are connected with the platform or road- " way," while " at the upper ends of such props or supports they " support the chains at points near where the next suspending " rods are connected to the chains."

The peculiarity in this construction of bridge is mentioned as consisting more particularly in the introduction of the props or struts between the chain and the platform, and at the same time making the platform capable of resisting compression, "the struts "acting not merely as stiffeners as when anything is braced, but "to support the structure."

[Printed, 10*d*. Drawings.]

A.D. 1856, September 11.—N° 2127.

TRUESDELL, Lucius E.—(*Provisional protection only.*)—"An "improvement in weight distributing bridges."

This invention relates "to a novel mode of trussing beams, "or of constructing frames of timber so as to distribute the "weight which they are intended to bear equally over the struc-"ture." The inventor provides a series of rafter timbers, which intersect each other at an angle of about 90°, the spaces created by the intersection of these timbers being square, and having one of their diagonal lines perpendicular to and the other parallel or nearly so with the string timbers, of which there are two on either side, between and to which the lower ends of the rafters are secured by bolts, the rafters being also halved into and secured to each other by bolts at their points of intersection. Between the angles of the squares thus formed by the rafters are secured horizontal braces, parallel with the string timbers, these being intersected at right angles by vertical braces passing between the upper and lower angles of the same squares, the whole well secured together, and the effect of the arrangement being that any weight or pressure laid upon any part of the bridge is distributed over the whole structure, relieving the parts immediately in the plane of the pressure from undue strain. The flooring is carried either by the string timbers, or by bed pletes secured to the horizontal braces.

[Printed, 4*d*. No Drawings.]

A.D. 1856, September 11.—N° 2128.

PITMAN, John Talbot.—(*A communication.*)—"Improvements "in the construction of iron bridges."

According to this invention the arches of the bridge "are of a "compound character, and are built up of wrought plate iron, in "such manner as to give the whole arch transversely the form "and strength of an arch, and to admit of very long spans with-"out excessive weight, presenting at once the combined features "of extraordinary strength and lightness."

In transverse section the plates forming the arch exhibit the figure of an isoceles triangle, with the base projecting on each side. The plates composing the arch are so arranged as to break joints, and in the middle of the plate forming the base of the triangle is a vertical plate, bolted thereto and secured at top to the plates composing the sides of the triangle by rivets. In order still further to increase the strength, and to prevent all risk of buckling of the plates, loose pieces of irregular form are adapted to the sides of the arch, which the patentee terms saddles, these being supported by the plates forming the arch, and also supporting each other by their edges, which come into contact. They are not secured to the plates, but rest mainly upon the projecting parts of the plates forming the base of the triangle, as mentioned above, and their upper edges receive a part of the pressure of certain " stirrups," which pass over the arch and support the suspension rods by which the floor of the bridge is sustained. The suspension rods are radial, or nearly so, to the curve of the arch, and they pass between two plates which compose the chord of the arch, and are bolted to a suspension plate on which those plates rest, the latter not being fastened thereto; and the effect of this arrangement " is, in case of great weight upon any part " of the bridge, to throw the strain upon the whole span at " once."

[Printed, 8*d*. Drawing.]

A.D. 1856, September 18.—Nº 2189.

WILSON, Richard.—(*Provisional protection only.*)—" Improvements in the construction of fireproof floors and ceilings, " applicable in part to the construction of bridges and other " structures."

This invention relates chiefly to a novel construction of metal beam or girder, which is composed of two lengths of sheet or plate iron put together in such wise that the beam or girder is " triangular in section," the upper plate being rolled to a " Λ-shaped " figure (in section) with flanges," and the lower length being flat, " with two hollow ribs or troughs to receive the flanges of the " upper plate." The plates " are bolted together by cross rods, " which pass through the three thicknesses of metal forming the " flanges and the hollow ribs or troughs, and these rods being " provided with stops will form struts for increasing the rigidity

" of the beam laterally, and when extended from one beam to " another they will serve for rafters, and carry the laths which " are to receive the plaster for forming a ceiling." The inventor proposes to fill the spaces inside the beams with cement or other non-inflammable substance, which will give solidity to the beams and prevent the plates from buckling. When used, the beams are placed "with the Λ side uppermost," the edges of the under plate forming supports for arches of suitable material between them, the inclined sides of the beam forming abutments for such arches. When such beams are used for a roof which requires a ceiling below the arches, strips of hoop iron or lengths of wire are lapped over the rods which extend from beam to beam, these strips or wires answering as laths to which cement is applied, which ceiling may be rendered ornamental by the use of a table "with a pattern (of panels, for example)," which will act as a mould until the cement has become hard, a plain table being used to sustain the cement when a plain ceiling is required, or the ceiling being plastered in the ordinary manner.

The beams are supported, in the case of a bridge, upon piers, between which the arches will extend. In the case of a building or other structure requiring floors and a roof, they are supported by the walls of such structure. The beams are meant to combine " strength and lightness."

[Printed, 4*d*. No Drawings.]

A.D. 1856, October 3.—N° 2315.

FONTAINEMOREAU, PETER ARMAND LE COMTE DE.—(*A communication.*)—" Improvements in the construction of roofs of " buildings, which improvements are applicable to the construc-" tion of arches of bridges."

According to this invention the arches of bridges, as well as roofs, vaults, and other parts of buildings, are constructed with timber or iron framing, " arranged in a similar manner to the " stones or voussoirs " of the arch of an ordinary bridge of masonry.

This improved arch "is composed of a number of iron or " wooden frames strengthened by diagonal cross pieces, firmly " secured together by bolts and nuts or other means. These dia-" gonally braced frames, forming the voussoirs of the arch or roof, " are also connected together at their sides and at the intrados or " profile of the arch by iron or other metallic plates bolted to the

" straight position by means of rods or struts connected or not to " the platform, and to curved or bent chains also hung from the " piers. These points are thus rigidly supported by the straight " chains or ties, and they carry the platform, which is made " sufficiently strong to support itself and the loads between the " aforesaid points. The platform itself may also be made to act " as a strut or tie. The land ties or chains are also made straight, " and supported in a similar manner. The chains or ties may be " made of links jointed together, or they may be wire ropes or " rods or plates, welded or rivetted or otherwise connected " together, or they may be made in the form of box girders, or " otherwise, as may be most convenient, as they are not re- " quired to be flexible like the chains of ordinary suspension " bridges. By these means rigid suspension bridges are produced, " which are adapted for railway traffic and other purposes."

Various modifications of the invention are described, including arrangements for a bridge " having an opening in the centre for " the passage of ships or other vessels," the patentee stating that what he claims as his invention is the constructing of suspension bridges " in such manner that the weight of the load, or of the " load and the platform, is sustained by inclined, straight, or " nearly straight, chains, extending from the towers or piers and " meeting or intersecting each other, and which are themselves " sustained or suspended in the required form by curved chains." The details of the invention will only be understood with the aid of the drawings annexed to the Specification.

[Printed, 1*s*. 10*d*. Drawings.]

A.D. 1857, September 19.—N° 2439.

PEAKE, William Henry.—" Improvements in the construc- " tion of beams, girders, and bridges."

According to this invention " a series of bars and plates of iron " are laid or built one on the other, and the whole are bound " together by means of bolts passing through the plates at " intervals, such bolts being fixed at top and bottom by " rivetting the ends, or it may be by screws and nuts, or other- " wise. The beams, girders, or bridges may be horizontal or " curved, according to the requirement."

In carrying out the invention " a plate is first laid, on the " middle of which a series of bars are piled one on the other, then

" another plate, and so on till the depth desired has been arranged, " there being a plate at top as well as at the bottom; the bolts " are then introduced and fixed in their places, there being a row " of such bolts on each side of piled bars, by which they are " retained in their proper positions along the middle of the structure. The different lengths of bars and plates used are arranged " to come with their ends butting together, but in such manner " as to break joints; and where the ends of the uppermost and " lowermost plates come together they are joined by a transverse " plate rivetted to the two ends."

[Printed, 6*d*. Drawing.]

A.D. 1857, October 2.—N° 2534.

JOHNSON, JOHN HENRY.—(*A communication from Francis C. Lowethorp.*)—(*Provisional protection only.*)—" Improvements in " the construction of iron bridges."

This invention relates, firstly, to "truss-frame girder bridges," and consists in so arranging the "upright posts" thereof that " they may be free to vibrate in the upper and lower chords." The upright posts have "rounded tops," fitting into caps with recesses formed in them in such manner that the posts can vibrate without moving the caps, but have no other movement independent of such caps. These caps have at one side a projection and at the other a recess, these fitting into and upon corresponding recesses and projections at the ends of the "straining pieces," the junctions of the latter and the caps being thus rigid on one side and free on the other, and these caps carry "shoe pieces" for the support of the longitudinal beams of the bridge, these beams being bolted to the shoe pieces, and the latter being so contrived that a longitudinal movement may be given to them without the caps partaking of such movement. The lower ends of the upright posts are recessed so as to fit upon rounded projections cast on metal plates, the projections which receive the outer posts being upon the "metal foundation plates," while those which receive the other posts rise from "metal combination plates," the lower ends of the posts thus being free to vibrate upon these projections.

" The diagonal and counter-diagonal tie-rods are connected by " simple eyes to bolts, one of which bolts passes through and is " secured to each of the caps, the head of such bolt forming an " eye, whereto are jointed the transverse struts and diagonal tie-

" rods, which serve to connect the caps of the opposite truss " frame to each other, and to steady the whole. The lower chord " rods are connected to the metal plates on which the posts " vibrate by means of screw threads and lengthened nuts. Rods " are arranged at each end of the girders, which rods serve to " retain them in position, and are secured by nuts to foundation " plates, and these are secured to the foundations or piers, such " plates being formed to receive the lower ends of the end posts, " as before mentioned, and are made adjustable to allow for expan- " sion and contraction occasioned by variations of temperature. " The flooring of the bridge may either be supported on the caps " in connection with the top chord, or arranged in any suitable " manner on the lower chord."

The invention relates, in the second place, to improvements in suspension bridges, and consists in using upright posts, similar to those of the truss-frame girder bridges, the lower ends of these posts vibrating in plates secured to the floor or lower chord, to which plates are jointed the lower ends of the diagonal tie-rods. The upper ends of the posts, which are rounded, work in recesses in "combination plates" to which the upper ends of the diagonal tie-rods are connected by pins or bolts, these plates being also furnished with short rods fitting loosely into holes in the plates and projecting on each side thereof, the projecting ends being screwed, and furnished with lengthened nuts into which are secured the screwed ends of the suspension or upper chord rods.

"The rods which form the cable are connected to the suspen- " sion or upper chord rods and to the top of the tower in a similar " manner."

[Printed, 4*d*. No Drawings.]

A.D. 1857, December 15.—N° 3084.

HOWARD, THOMAS.—"Improvements in machinery or ap- " paratus for rolling iron bars used in the construction of " suspension bridges and otherwise."

These improvements are thus defined :—"My invention relates " to improvements upon an instruction for which Letters Patent " for England were granted to me on the 6th of October, 1845, " and consists, primarily, in the adapation of moveable collars for " the purpose of adjusting the rollers for variable lengths of bars, " and when several enlargements, projections, or as I formerly

" termed them, 'heads,' are required of the same or different " forms in the length of the same bar."

"I employ, by preference, wrought-iron shafts to receive the " collars or bosses in place of cast-iron rollers, in order to give " sufficient length and strength, and at the same time, for the " purpose of reducing the weight, to diminish the momentum " required by the machinery in the to-and-fro motion."

"I also employ a trough or other analogous appendage having " vertical sides attached to the finishing rollers, to prevent the " enlargements, projections, or heads from deviating materially " from parallelism with each other, and with the intermediate " parts of the bars, during the process of the final rolling. And " further, I give motion to the rollers or shafts by means of " jointed spindles, situated intermediately between them and the " driving pinions, instead of placing the latter immediately upon " the ends of the rollers or shafts, in order to render them capable " of admitting a greater variety of thicknesses in the slabs or " pieces to be headed or enlarged by the pressure of the bosses " attached thereto."

[Printed, 4*d*. No Drawings.]

A.D. 1857, December 22.—N° 3139.

KENNARD, ARTHUR CHALLIS. — (*A communication.*)—" Im" provements in trussed iron bridges."

The essential characteristic of this invention is the "construct" ing trussed iron bridges with parallel top and bottom rails, and " diagonal wrought-iron struts and ties of angular or V-form " connected at their bases to the transverse girders."

To the bottom rail are connected castings which sustain transverse wrought-iron girders upon which the roadway rests. These transverse girders being bolted to the castings, or "pedestals," and the latter "being connected at each end to the branches of " the angular struts and ties, the whole structure is rendered stiff " and strong in a lateral direction, and the lateral deflection of " the top rail is prevented without the necessity of employing " diagonal cross ties between the top rails. The particular mode " of connecting the angular struts and ties to the transverse " girders may be varied, provided the connection be stiff and " strong in the lateral direction, or transverse to the bridge."

[Printed, 10*d*. Drawing.]

1858.

A.D. 1858, April 10.—Nº 771.

ORDISH, Rowland Mason.—" Improvements in suspension " bridges and suspended girder bridges."

After referring to various arrangements which have been adopted in the construction of suspension bridges with more than one span, the patentee states this invention to consist in the employment therein of " chains running from tower to tower, in straight " or nearly straight lines, anchored to abutments at each end, and " supported by struts or ties from curved chains, also anchored " to abutments, and which carry the straight chains and prevent " any strain in them from their own weight." These straight chains are connected with the chains supporting the roadway at the towers, and transmit any strain caused by loads on the platform directly to the abutments, thus preventing any disturbance of the equilibrium of the unloaded spans, with the exception of that due to the extension of the metal of the chains, either from its elasticity or from increase of temperature.

Diffierent modifications of the details of the invention are described. For instance, in some cases, instead of the straight chains being anchored to abutments in the ordinary manner, they may be also connected to heavy weights at one end or at both ends of the bridge, so that the chains shall be always stretched by the weights. The patentee mentions that this arrangement enables suspension chains and girders to be combined without danger to the latter from variations of temperature. In other cases, instead of straight chains passing from tower to tower being employed, the chains which carry the load are connected with longitudinal girders or beams in such a manner that by applying weights to the girders or bearers they are always stretched. And in other cases the bridge is constructed by combining with curved chains suspended between the towers, straight or nearly straight chains connected to the curved chains at various points, and running to the lower parts of the towers, these chains being retained in straight or nearly straight lines by being suspended or supported by the curved chains or by the platform, the latter being suspended from the curved chains. " The straight chains resist the tendency there

" is in the curved chains to alter their form by moving or un-" equally distributed loads." This part of the invention is described as being applied to a bridge of one span only.

The invention is set forth at some length, reference being also made to an invention for which the present patentee obtained a patent on the 7th of March, 1857.

[Printed, 8*d*. Drawing.]

A.D. 1858, April 30.—N° 972.

JOHNSON, JOHN HENRY.—(*A communication from Freidrich Schnirch.*)—" Improvements in suspension bridges."

This invention relates " to a peculir construction and arrange-" ment of the suspending chains of suspension bridges, whereby " increased rigidity and a greater span is obtained, with con-" siderable economy in construction."

According to this arrangement " the suspending chains are " rendered stiff or rigid by the application thereto of diagonal " braces. Two or more chains are used for each side of the " bridge, such chains being suspended at different elevations, so " as to form concentric curves, and the intervening spaces between " these curves are occupied by the diagonal braces above referred " to, which are connected at each end by pins or bolts to the " upper and lower chain, and are so arranged as to subdivide the " space between the chains into a succession of triangles, having " their apices alternately above and below, whilst the hypothenuse " of each angle is formed by the corresponding link of the upper " or lower chain, as the case may be. The links of the lower " chain should be, of course, of a greater length than those of " the upper chain, to allow for the greater radius of the curve of " that chain over that of the upper one."

The platform or roadway of the bridge, " which may be of any " convenient construction, is supported in the usual manner by " suspension rods or links," some of which are connected to the upper and others to the lower of the suspending chains.

[Printed, 8*d*. Drawing.]

A.D. 1858, June 8.—N° 1292. (* *)

BUNNETT, JOSEPH.—This invention has for its object an improved construction of floors, roofs, and arches, formed of hollow earthenware or clay blocks made by " expressing clay through

" moulding orifices or dies," and which form when put together a very flat arch, springing from angle plates or other suitably shaped plates of iron, resting on the walls and securely tied together by iron tie-rods, at proper intervals, which rods it is preferred should pass through the hollow blocks of earthenware. The form of the blocks may vary somewhat, but it is recommended that they should have their opposite sides parallel, each side having a kind of zig-zag section, composed as shown on the drawing, of two parallel inclines and a nearly straight portion; the ends where the blocks of a rim or arch abut against one another to have the same section or some other form that will enable them to fit into each other.

The ends of the arches "may be built into walls or carried by " piers or other supports" " whether for the construction of floors " or roofs of houses or other buildings, or for bridges or other " like structures."

[Printed, 6*d*. Drawing.]

A.D. 1858, August 5.—N° 1787.

CLAY, WILLIAM.—(*Provisional protection only.*)—" Improve- " ments in the construction of certain descriptions of bridges and " girders."

This invention consists "in the application of wrought steel to " the construction of girders and bridges of those kinds for which " wrought-iron has been hitherto employed."

The inventor states that he uses " plates of steel, either plain or " corrugated, and bars of any suitable section, according to the " form of girder or bridge to be constructed."

" From the great strength, rigidity, and tenacity of wrought " steel, and also in consequence of its resistance to compression, " great additional strength and stiffness are obtained, together " with a considerable decrease in the weight of the structure."

[Printed, 4*d*. No Drawings.]

A.D. 1858, November 8.—N° 2494.

DENDY, ARTHUR HYDE.—" Improvements in the construction " of breakwaters or wave screens, applicable also in constructing " bridges, roadways, piers, jetties, landing stages, and other " structures."

This invention consists in constructing (in the first place) a breakwater by the employment of a number of open tubes, these tubes being each of a length considerably greater than the diameter, and such tubes being laid in such a position with reference to the action of the waves that the latter are compelled to pass through them, by which their percussive force is counteracted. These tubes are arranged in series, one above another, and they may be round, hexagonal, or of any other form, and either straight or bent, or, if necessary, of a tapering form, which last form is useful in constructing a curved breakwater. And the tubes may be connected together by rings, bolts, or other mechanical appliances, or by cement, the tubes being either all parallel, or some placed diagonally with the others; and either all close together or with spaces between them, being all of the same length or of different lengths, according to the circumstances of the case, and they may be supported by arches, piles, or any other suitable substructure.

Such a structure as this having "a road or gangway super-" imposed thereon," will then serve as a bridge, or as a pier, jetty, or landing stage, and may also form the substructure of a lighthouse or other erection.

The patentee mentions various advantages as being possessed by this invention over other inventions having similar objects.

[Printed, 10*d*. Drawing.]

A.D. 1858, November 13.—N° 2550.

SWAN, Michael.—(*Provisional protection only.*)—" Improve-" ments in the construction of floating docks, and other floating " structures."

"According to this invention, when applied to the construction " of floating docks, it is proposed to construct the dock of two or " more pontoons, connected at their lower or under edges by " means of strong girders supporting a cradle; the span between " the pontoons, that is to say, the width of the cradle, being " sufficient to receive a ship. These pontoons and cradle are per-" fectly air-tight at the top and sides, but are open at the bottom " in place of being closed, as heretofore, so that the water is " allowed to rise more or less within them, according to the " quantity of air contained in or forced into the upper part. By " having suitable air-pumps connected with the pontoons for the

" purpose of forcing air therein, and furnishing such pontoons " with escape valves, it is obvious that they may be floated or " sunk, as desired, by simply forcing air in or letting the air " escape. The engines for working the pumps may either be " carried on the decks of the pontoons or in water-tight compart- " ments made inside the same; and separate air-tight bulkheads " may be made in the pontoons for the purpose of increasing the " buoyancy of those parts of the pontoons subject to the greatest " pressure or weight. The two or more pontoons should be con- " nected by a pipe or pipes, so that an equilibrium of air pressure " may be maintained therein. This pneumatic principle of " mouthed pontoons may obviously be applied to the construc- " tion of floating pontoon bridges, landing stages, and other " similar floating structures."

"The details of construction may in all cases be considerably " modified so long as the main features of this invention are " retained."

[Printed, *4d.* No Drawings.]

A.D. 1858, December 22.—Nº 2924.

KENNEY, Michael.—" Improvements in bridges."

This invention relates to sliding or rolling bridges, and the improvements consist in " constructing the roadway or the longi- " tudinal framing of the bridge as a double incline platform; the " platform is mounted upon bearing rollers, which if the bridge " were free to rise and fall would enable it to do so, it being " balanced thereon; thus upon withdrawing the bridge or moving " it backward and forward, the power required is chiefly that " which is alone necessary to overcome the friction of the rollers " with their load running over the rails. The top face of the pit " over which or in which the bridge moves backward and forward " is level, and it may have two or more edge rails, railway bars, or " tram plates arranged longitudinally therein or thereon, and " upon which the central bearing wheels supporting the bridge " will run. The platform or framed roadway may be trussed on " the top sides of the longitudinal beams or trellis girders, or a " bow and string or other such contrivance may be adopted to give " stability or stiffness, and to resist longitudinal flexure, and the

" roadway or bridge platform may be quite level instead of being " cambered, and the necessary amount of rigidity may be given by " the girders or trussing."

For the purpose of opening and closing the bridge, racks and pinions are by preference employed. On the under side of each side frame or longitudinal girder is fitted a rack or its equivalent, " which takes into a corresponding pinion wheel or its equivalent " projecting above the line of the face of the pit, and motion may " be communicated to the pinions; the tail end of the bridge is " drawn inward and projected above the level of the ground line, " along which the under side of the platform moves, and wheels " or rollers may be fitted to the extreme tail end of the bridge " platform, as there should in like manner be a roller at the " opposite or outer and overhanging end of the platform, for " enabling the platform to come to rest, and take its bearing " upon the opposite abutment, when it has been projected across " or moved into its proper position, where it may be secured by " locking wedges, cams, or by other means. When the bridge is " in sitû the central bearing rollers or wheels approach nearly to " the face of the supporting wall, pier, or abutment, on the side " upon which the balanced or tail end of the bridge runs, and the " top side of the platform at each end becomes level with the " ground line of each approach, the platform of the bridge itself " either forming a double incline of slight elevation, the centre of " its length being the highest part of the roadway, or it may be " level as before-mentioned."

Several modifications of the invention are described, in some cases the racks being so curved at the end of the bridge that on the pinions being turned, the tail end of the bridge rises, and the whole moves backwards simultaneously. In other cases the racks are not connected to the bridge, but placed in the "tail " pit" below it, wheels gearing with these racks being connected to a "carriage" on which the bridge rests, and furnished with winches and gearing for turning such wheels, the tail end of the bridge being raised by vertical racks and pinions with separate winches. These arrangements are more particularly applicable to railway bridges, and one modification is described in which certain beams are placed in line with the bridge, these beams carrying rails, "to make good the connection between the land side and " the bridge;" such beams resting upon a fulcrum at the outer

end, and being capable of being lowered at the other end to allow of the bridge being drawn back over them.

[Printed, 1*s*. Drawings.]

1859.

A.D. 1859, January 13.—N° 112.

BANKS, DANIEL LANCASTER.—"A method of constructing a "travelling suspension rail or roadway, applicable, among other "uses, as a bridge and lifting agent."

According to one part of this invention a travelling suspension "bridge or roadway is composed in the first place of two strong "travelling frames or carriages, the wheels of which rest upon "rails laid down upon each side of the space to be crossed," these carriages sustaining "timber or other frames or buttresses," which carry pulleys over which the suspension ropes or chains pass to sustain the platform of the roadway or bridge. These ropes or chains and the parts suspended therefrom may be of any construction usual in suspension bridges, but in order to tighten or slacken the ropes or chains at pleasure, the latter, after passing over the pulleys above-mentioned, are carried down beneath other pulleys and thence to "windlasses or other mechanical purchases" with which the buttresses are provided. The bridge or roadway may thus be placed in such a state of tension as to be suitable for travelling either at right angles with the lines of rails or at other angles therewith; the buttress frames themselves being so mounted as to be capable of swivelling or turning upon the carriages.

In order to enable the carriages firmly to sustain the weight of the bridge a bar or strut projects downwards from each, and is provided at its lower end with a pulley or roller which runs in a channel formed between and below the lines of rails, flanges on each side of the channel preventing it from rising upwards; and the buttresses are further provided with weighted levers, which may be placed in different positions so as to offer more or less resistance to the tendency of the ropes or chains to pull the buttresses inwards; and each buttress may, if desired, carry a crane for raising and lowering articles to or from the roadway or bridge. The latter may, if necessary, be supported at certain points "from

" below;" by wheels placed below frames provided with springs, and "by light iron tie rods."

The lines of rails are provided with turntables by which the whole structure may be moved from one line of rails to another; or, if desirable, rails may be dispensed with and the carriages rest upon the ground. Access is obtained to the bridge by inclined planes at each end, and when used for railway purposes the space between the rails on the bridge may either be closed or open; in the latter case the rails being connected by "bow stays." Carriages for travelling upon these rails may either have the bodies suspended from the axles, or mounted above them, and when the space between the rails is open, may be used for dragging "an " implement or load" across the ground or space spanned by the bridge; and the whole structure may be moved along the rails on which it is mounted, or along the ground, by means of anchors or screw piles, and chains, ropes, " or other connections," acted upon by some suitable prime mover. The rails for carrying the structure may, if desirable, be mounted on pontoons or other floating objects, or be suspended from posts, which, again, may either be fixed, or be furnished with wheels so as to render them easily removeable. And an arrangement is described in which one frame or buttress is set up in the centre of a circle, and a line of circular suspension or other railway established round it. This arrangement, however, is by no means clearly set forth, and, moreover, does not appear properly to come within the subject of this series of Abridgments.

[Printed, 10*d*. Drawing.]

A.D. 1859, January 21.—N° 197.

NEWMAN, JAMES. — " Improvements in the manufacture of " chains."

The object of this invention "is to obtain increased strength " to chains which are subject to great strains when in use," and it "applies to that class of chains the links of which are con- " nected by pins or rivets, which serve as axes on which the links " move," such chains being usually employed for suspension bridges and raising minerals from mines or pits, as well as other purposes.

This object is accomplished by forming bosses or "curved pro- " jections" round the holes made for the reception of the pins in certain of the links, which bosses or projections fit into corresponding recesses in the other links of which the chain is composed, and these bosses or projections forming in fact the axes of the links, the pins or rivets, which pass through the holes from side to side of the chain as usual, merely preventing the links from separating laterally. Different modifications of the invention are described.

In the Provisional Specification the invention is described as consisting in the introduction of "washers" into recesses in the links, these washers forming in effect the axes of the links, and the pins or rivets merely binding the links together. It is obvious that either the washers or the bosses, being of much larger dimensions than the pins or rivets, will bear a much greater strain than the latter.

[Printed, 10*d.* Drawings.]

A.D. 1859, February 17.—N° 445. (* *)

FRAISSINET, PIERRE EDOUARD.—"A new or improved structure of iron applicable for paving, flooring, bridges, gratings, " girders, and other like purposes."

"This structure is formed of strips of hoop or other iron com- " bined, some of the pieces being flat, and others undulated, " placed on edge, juxtaposed and rivetted at the points of contact." "It can be formed of any length and width, and its " weight will vary according to the size of the strips of metal " required for the purpose intended."

In constructing bridges, "the arch centre being formed " between the abutments, the straight and undulated strips of " convenient dimensions are bent and combined as described, and " according to the arch formed by the centre, and the openings " are filled with concrete or cement."

[Printed, 6*d.* Drawing.]

A.D. 1859, March 21.—N° 707.

HAGGETT, WILLIAM.—"An improved method of treating " metals and other materials to increase their strength."

This invention consists "in giving to iron and other metals, " by rolling, pressing, or casting, an undulated surface, composed " of longitudinal and transverse corrugations, crossing each other " *at right* angles, or diagonally at such other angles as may be

" most advantageous for the purpose to which the prepared " article is to be applied; and also in giving a similar surface to " wood, cardboard, papier mâchie, and all other materials capable " of being pressed and moulded, whereby an ornamental surface " is produced, and the strength of all such metals and other " materials is increased, rendering them more suitable for many " architectural and mechanical purposes."

Different modifications of the invention are described, including the application thereof to bars or plates of metal with flat surfaces, and also to round bars. Bricks, both of clay and wood, as well as tiles, are also described as being formed with such corrugations on their upper and under surfaces, bricks so formed " mutually interlocking " when laid together, and being valuable in the construction of sea walls and other erections exposed to great lateral pressure. Tubular and other beams for building, railway, and other purposes, may be formed of two or more plates of iron thus corrugated, or of such plates with timber (similarly corrugated) interposed between them, or of a single iron plate so corrugated, with a corrugated beam of timber on each side of it.

The invention is applicable in various forms in the construction of bridges of all kinds, canal locks, and aqueducts, boilers, pipes, chain cables, and other chains, houses, and other structures and erections.

[Printed, 6*d*. Drawing.]

A.D. 1859, April 11.—N° 908.

BARLOW, William Henry.—" Improvements in beams and " girders."

This invention relates to beams and girders which are furnished with one or more intermediate supports in addition to the two terminal bearings. The patentee mentions that such beams, when made of equal depth and section throughout, are most liable to break at the places directly over the intermediate supports, owing to the downward pressure or flexure of the parts of the beam between such supports causing the " curvature " over the points of support to be " sharper " than it should be. This he proposes to remedy by increasing the depth of the beam over or near the intermediate points of support, whereby not only is greater strength obtained over such points of support, " with the same " quantity of material in the flanges, but the radius of curvature

" of the upward flexure is rendered greater, that is to say, the " curve is flatter, and the points of contrary flexure are thereby " moved nearer to the centre of the span, so that the sectional " area of metal in the flanges throughout the centre portion of the " beam, between the points of contrary flexure, may be consider- " ably reduced without diminishing the strength of the beam " when compared with a beam of equal section or of equal depth " throughout," "so that a great economy of material results " from this mode of construction." Different modifications of this part of the invention are described, in one case the girder having "lattice or openwork sides," while in another case the girder has "plated sides," such girders being used in the construction of bridges, while in other cases continuous beams of cast iron are employed for the same purpose.

The invention also includes, in relation to iron beams or girders, "the employment of a stronger material, such as puddled " steel, to form the whole of the centre portion of such girders, or " the principle parts thereof, for a length equal to from one-third " to one-half of the span," for the purpose of obtaining "the " requisite strength in this part with a much less weight of " material."

When puddled or Bessemer's steel is employed in combination with wrought iron, the steel is to be used "in the upper and lower " flanges of the centre portion of the girder, but in consequence of " the cost of the material only in those cases where the spans are " so large that the weight of the girder exceeds the weight of the " load, and it becomes of importance to reduce the weight of the " girder by every practicable means."

[Printed, 1*s.* 2*d.* Drawings.]

A.D. 1859, April 12.—N° 918.

CASTAY, MATHIEU.—" Improvements in metallic bridges."

According to one part of this invention three longitudinal bars or bearers are used, placed one above another, and connected by diagonal bars crossing each other, and also if desirable by vertical bars, this arrangement forming a frame or girder for a bridge, and such frames or girders being of any requisite dimensions. The longitudinal bars may be either single or double, and connected by either one or two series of diagonal bars, and the longitudinal bars may all be either straight or curved; or the middle bar may be straight and the outer ones curved; or the lower bar may be straight and the upper ones curved, which last arrangement the patentee states to be preferable for general adoption, the lower bar supporting the roadway.

According to other arrangements, instead of the diagonal cross bars, " circles or rings " are used to connect the longitudinal bars, being bolted to them at different points in their circumferences, and such circles or rings having in some cases bars passing across their interiors ; or instead of complete circles half circles only may be used, " intersecting each other reciprocally, having single or " double series superposed or in juxtaposition." In other cases the longitudinal bearers are connected by elliptical rings.

The bearers and cross bars or rings and other metallic parts of the structure may be formed either from a single sheet of metal, or of two or more thicknesses of metal superposed, with an extra thickness at the edges to give additional strength. It is meant of course that two or more of the longitudinal frames or girders shall be used in the construction of a bridge, these being placed parallel with each other, and connected by cross pieces for supporting the roadway.

[Printed, 1*s*. Drawings.]

A.D. 1859, April 25.—N° 1040. (* *)

WARNE, William, FANSHAWE, John Americus, JAQUES, James Archibald, and GALPIN, Thomas.—This invention consists of improved compounds capable of resisting a high degree of heat, and applicable for packing the joints of steam or other pipes, and also for packing or lining parts of machinery in general, or parts of ships, bridges, tanks, or railways. The materials which it is proposed to employ for making the improved compounds are caoutchouc or india-rubber, gutta percha or other elastic or flexible gums; bituminous, resinous, or gelatinous substances, or any or all of these, either alone or in combination; to which must be added iron, steel, or other metal filings or borings, or ores of iron or other metals, or oxide of iron or manganese or other metals, or earthy matters containing iron or other metals.

[Printed, 4*d*. No Drawings.]

A.D. 1859, May 20.—N° 1248.

TEASDEL, William.—(*Provisional protection only.*)—" Improvements in coffer dams."

This invention relates to a peculiar construction of coffer dam which the inventor terms the "Nautilus coffer dam." "This dam is "planked vertically on horizontal 'waling,' and is caulked with a "single tier of sheet piles driven a short distance into the ground, "with at intervals a wedging or closing pile. In some cases "where the bed is composed of stiff mud, clay, or peat, the sheet "piling may be dispensed with, the settling down of the dam "being effected by the aid of hollow air-tight wings placed at the "sides thereof, into which wings water may then be allowed to "enter, or bags of ballast introduced for the purpose of sinking "the dam, and keeping it firmly down upon the bed. To pre-"vent the pressure of water underneath the bottom of the dam, "stout canvas aprons are secured to the lower part thereof, and "fastened on the outside of the dam to a chain, and drawn out so "as to lie on the bed, and held down by sand bags or other "suitable ballast."

"The piles are confined between double wales at back and "front, the back wales being part of the structure, whilst the "inner ones are free to be raised or lowered, secured by uprights "and fastened by screw eye-bolts." This dam, by means of the wings referred to above, "can be floated in very shallow water," and when required for "single piers and deep water" may be floated by means of a false bottom, one end of the dam being removed on a pier being finished, and "the whole taken for a "second pier."

Printed, 4*d*. No Drawings.]

A.D. 1859, July 4.—N° 1591. (* *)

BROOMAN, Richard Archibald.—(*A communication from Job Johnson.*)—Powder or mixture for refining and steelifying iron.

According to this invention, take quick or caustic lime, free from earthy or foreign substances, and add to it an equal quantity of bone dust or baked bones finely divided, and a like quantity of charcoal; mix these ingredients intimately, and expose them to the influence of the weather for one, two, or more days; then take any convenient form of cementing or converting furnace, and interstratify the articles of iron to be operated upon with the mixture till the furnace is charged; afterwards close and lute with fire-clay, and apply heat externally. "By this means and

" process I am enabled to give to iron entirely new properties and " qualities, as well as" to convert or partially convert it "into " steel at pleasure. Iron, subjected to this treatment, assumes great " rigidity and hardness without losing its property of malleability " and ductility. Shafting, piston rods, axles, journals, and such " like, may be hardened and strengthened by an exterior coating " of steel, possessing all the properties of cast steel, whilst the " interior retains all its fibrous structure. In like manner, railway " bars, wheels, chains, anchors, anvils, and large articles " generally may be hardened and strengthened to any required " extent, whilst smaller articles" "may be finished in iron, and " then converted, or partially converted, into steel, without impairing " their forms or requiring reconstruction. This process " also gives to iron the property of resisting oxidation in a high " degree, and amongst other things is most important in its " application in preparing plates for shipbuilding, boilers, bridges, " and other like purposes."

[Printed, *4d.* No Drawings.]

A.D. 1859, September 9.— N° 2059.

ALLEYNE, John Gay Newton.—"Improvements in the " manufacture of wrought-iron beams."

In setting forth the leading features of this invention the patentee, after making some observations upon the defects of the ordinary systems of manufacturing wrought-iron beams of large dimensions, and referring to the practice of two bars being welded together in forming such beams, says:—"By the present invention " I weld the two bars together with the intervention of an " intermediate bar or 'glut piece' of **H** form, or having two " grooves which receive the edges of the two bars and protect " them from excessive oxidation during the process. The two " sides of this intermediate bar may be hammered down quite flat, " if desired, so as to reduce the joint to the same thickness as " the rest of the bar, or the joint may be left somewhat thicker, " if preferred. Three or more bars may be united by two or " more of the **H**-formed bars, if desired. Thus beams for bridges, " or for the decks or ribs of ships, or other purposes, may be made " of a **T**-shaped bar, or an **L**-shaped or other suitable bar united " to one edge of a plain flat bar, whose other edge is united to " another **T**-shaped bar, or to a bar with a single flange, or with a bead along one or both sides of its edge, one of the H-formed intermediate bars being welded in at each junction. Instead of the H-formed bar I sometimes use a flat bar of greater width than the thickness of the beam, so that when hammered or compressed it is squeezed into a somewhat similar form. Or a T-shaped bar may be used, and the edge of the straight part or web hammered up or compressed in a similar manner. I heat the parts to be welded by passing them successively between two small blast furnaces or cupolas, or by heating the whole length of the joint or the whole length of the beam by means of one or more furnaces constructed of suitable form, or by inserting the whole beam into a furnace of suitable dimensions; and I weld them by hammering on the top or sides or both, or by pressure applied by rollers or otherwise, or by both or all of such means. In welding bars together when the edges are heated by the small cupolas, as herein-before mentioned, I use a clip and a wedge, or screw, or similar means, to hold the two bars together at some distance from the point which is being welded. The expansion of the edges of the bars tends to make them curve away from each other, but the clip causes this expansion to force the edges together at the part which is being welded."

The patentee then states that "the operation of heating and welding the bars may be performed in various ways," and then proceeds at considerable length to state the various modes in which the invention may be carried into effect, mentioning, in one part of the description, that he has found it advantageous to "make the glut of a quality of iron which is more fusible or more easily welded than the iron of which the other bars are made," such a glut protecting to a great extent the edges of the other bars from being oxydized or burned. "It is itself partially burned or oxydized, but still furnishes metal enough to make a good junction." He finishes the Specification by stating that what he claims is,—"the manufacture of wrought-iron beams consisting of a web with a flange or flanges, or a bead or beads, or a projection or projections at one or both sides of one or both of its edges by welding together two or more wrought-iron bars, with the intervention of one or more of the small bars of iron" which he denominates "a glut or gluts," and in the manner set forth.

[Printed, 10*d.* Drawing.]

A.D. 1859, November 2.—N° 2495.

BUDDEN, JOHN LEGGETT.—(*A communication from Woodford Pilkington.*)—" Improvements in forming and driving piles for the " construction of piers, jetties, viaducts, bridges, or other works " where piles are usually employed."

According to this invention piles are formed of bars of iron of any suitable shape, " combined with a solid pointed shoe or foot, " which is driven into the earth by means of an independent ram " or punch as hereafter described. Each pile may be formed by " combining several of these rods or bars according as the piles " are required to be of triangular, square, or polygonal form. The " ends of the piles where they enter the ground are formed by " bending the lower end of each rod employed to form the pile, " and drawing it to a point, the cluster of rods forming the pile " being kept in shape at the point by welding, or by fixing the " points in a 'shoe,' or by ring ferrules driven over the ends of " the rods; and piles constructed as above described may for " distinction be termed 'solid-footed skeleton piles.'"

These piles are driven by means of a solid foot, which enters among the bars forming the pile, resting in the conical space at the foot where the bars are bent to form the point, this foot being acted upon by a ram or punch placed upon it, and struck by the monkey of the pile engine. This ram or punch is removed when the pile is sufficiently driven, and a " centre rod or bar " is fixed in the midst of those composing the pile, a " central bearing " from the solid foot being thus obtained, the whole pile being rendered " rigid " by discs, plates, or bars formed with holes so as to slide over the rods or bars, and fixed at suitable distances by keys or wedges. If required such piles may be then lengthened by other sets of bars or rods placed upon them, and connected therewith by coupling boxes. The superstructure may also be connected with the piles by coupling boxes, or by other suitable means, such superstructure being of iron in suitable forms, either alone or in combination with wood.

Piles formed of bars may be used for works on rocks, where ordinary piles cannot be driven, the bars for forming the piles being placed separately in holes bored in the rock to receive them, and being then connected at their upper parts by metal discs or plates, and couplings, as already explained. The "foot" in this case is unnecessary.

[Printed, 10*d*. Drawing.]

A.D. 1859, November 15.—N° 2585. (* *)

WARD, William Henry.—"An improved turntable for rail-"ways, and other purposes."

This invention consists, "first, in supporting and centering the "turning platform of the table without the aid of the central pivot, "by means of hollow spherical balls, or spherical tread wheels "arranged between circular-grooved tracks, of such form in their "cross section as to admit freedom for said balls or wheels to "turn."

"Second, in operating the table by means of a crank shaft and "gear wheel near the centre of the platform."

"Third, in supporting the ends of the track timbers by means "of knee joints."

"Fourth, in operating the knee joints by means of a hand "lever near the crank shaft for convenience while operating the "table."

These turntables are mentioned as being not only applicable for railway purposes, but also for the turning platforms of swing bridges, mortar beds, and pivot gun carriages.

[Printed, 6*d*. Drawing.]

1860.

A.D. 1860, March 2.—N° 580.

EDWARDS, George.—"Improvements in caissons and founda-"tions for bridges, piers, and other structures under water."

This invention consists "in the use of a caisson, with a bottom "of sufficient strength to carry the required superstructure, such "bottom having formed in it a number of holes corresponding "with the number of piles intended to be driven or worked into "the ground, such holes being also of the size of the piles in "their cross section. The holes or sockets for the piles are pro-"vided with stuffing boxes packed with an india-rubber ring "or other elastic packing, to prevent the water from entering the "caisson, which is thereby rendered water-tight."

The patentee states that in some cases he prefers to use "piles "screwed throughout, in which cases the holes or sockets should "have an internal screw formed in them, so as to form the nuts "*for the piles;* and when the ordinary piles, or those with a screw

" only at the point for passing into the ground, are used, the said " holes or sockets need only be cast cylindrical."

"The caisson may be made in water-tight compartments, in " order to facilitate the sinking of the same to its required depth " by letting water into some of these compartments while the " remainder are empty. But the caisson may be otherwise con- " structed, and sunk to its required depth."

In some cases the caisson may be closed at the top in order to admit of the employment of compressed air for driving the piles.

[Printed, 10*d*. Drawing.]

A.D. 1860, April 25.—N° 1040.

TARTE, XAVIER, and TOOVEY, WILLIAM.—" Improvements " in the construction of floorings and roofings and other parts of " buildings and other structures, which improvements are also " applicable to the construction of bridges and other works."

" The object of these improvements is to obtain lightness and " strength in the construction of parts of buildings and other " structures, and to render such parts of buildings fireproof."

"For these purposes are formed light framings of wrought " metal, which are covered on the upper, and, if desired, on the " lower side with plates of sheet metal, the whole being united " together by nuts or screws, or other suitable bolts. When for " floorings, the upper surface of those constructions may be " covered with wood or any other suitable material, and the " under surface with lath and plaster or any other suitable " material to form a ceiling."

" Sometimes the surfaces are formed by means of plates laid in " angular channels, and connected together across the upper and " lower angles by transverse straps or plates, or by the aid of " blocks of wood when for roofing."

Various modifications of the invention are described, in some cases iron bars or bands, crossing each other at right angles, being notched at the intersections "to half their thickness, so as to fit " one into the other," and carrying plates, woodwork, or plaster, as most suitable to the purpose for which the structure is intended, In other cases the bands or bars are placed so as to form a circular or arched structure, while in other cases, again, a straight upper and lower bar are connected by plates so bent as to constitute " an

" uninterrupted union of equilateral triangles." This last mentioned arrangement is set forth as being specially adapted for use in the construction of bridges and viaducts, while the circular or arched arrangement is described as being suitable for tunnels, submarine structures, and also for "spanning great openings." The details of the invention will not, however, be completely understood without the aid of the drawings annexed to the Specification.

[Printed, 1*s*. 6*d*. Drawings.]

A.D. 1860, April 26.—N° 1052.

BUCKWELL, William.—(*Letters Patent void for want of Final Specification.*)—" Improvements in the construction of iron " roofs and bridges, and in apparatus to be used in their " erection."

These improvements are thus set forth :—

" This invention relates, firstly, to a mode of applying rods, " which are subjected in the building of roofs or bridges to tensile " strain, so that their full cross section shall be available for the " support or stiffening of the structure. To effect this object, I " avoid the use of punched bolt holes in the tie beam rods to " secure the rods in position, and employ, in lieu of bolts or such " like fastenings, a tie or coupling of peculiar construction, which " may be made compensating where great variations of temperature " render the same desirable. The tie-beam rods I form with " rounded shoulders at their coupling ends, and I cause the " rods to be coupled to overlap sufficiently to allow of my improved " fastening being inserted between them. To the upper " and under side of the rods I apply metal trusses (say brass, " when compensation is required). The ends which bear against " the tie rods I slot, to allow them to embrace the rods, and I " fit them with a cross pin, which bears against the inner side of " the adjacent shoulder of the tie rod. The other ends of the " trusses at either side of the tie rods abut against each other, " and bolts from suspended plates pass outwards and between " the abutting ends of the trusses, and are secured by nuts outside " the coupling. These plates are circumscribed by a pair of " rings, which form bearing surfaces for the plates. The pins in " the trusses on the opposite sides of the tie rods may be linked " together, if thought desirable, and it is by an opening or lug

“ bearing upon pins that lie against the shoulders of the tie rods
“ that I secure these rods to supporting cast-iron or other pillars,
“ the ends of the open link or lug being tapped and inserted into
“ the pillar, at the inner side of which binding nuts are applied
“ to these ends.”

“ For lifting the beams of roofs and bridges and other weights
“ into position, I employ lifting gear of the following construc-
“ tion, the main objects being to obtain uniform leverage capable
“ of being multiplied to any required extent, and to prevent the
“ twisting of the hauling rope or chain. The lifting gear I
“ mount in a carriage with travelling wheels, and this carriage I
“ mount on another carriage similarly provided, so as to secure
“ a lateral and a backward and forward movement. This appa-
“ ratus may be said to consist of a chain barrel mounted on a
“ central horizontal shaft, which is driven by spur gearing on a
“ shaft mounted parallel therewith, and on one side thereof.
“ Chain pullies on either end of this shaft, with V grooves, are
“ provided, to enable the attendants to impart motion thereto by
“ means of endless chains or ropes lying in the grooves of the
“ pulleys. Above the chain barrel shaft, and in a line with the
“ driving shaft, is another shaft, fitted with spur gearing and
“ chain pulleys, which may be used when additional power is
“ required to be exerted to raise a heavy load. On this shaft a
“ spur wheel is mounted, so that it may be thrown in or out of
“ gear with a pinion on a third driving shaft, fitted with chain
“ pulleys. By this arrangement, therefore, the lifting power may
“ be still further augmented, the workmen applying themselves
“ to the chains carried by these additional pulleys. The traverse
“ of the apparatus over the rails on which the travelling wheels
“ bear is in like manner effected by chains and pulleys, which set
“ in action worm shafts in gear with worm wheels on the axles
“ of the travelling wheels. The hauling chain I use double,
“ forming a double ring of recesses in the barrel for the same to
“ bed into, and I connect them together by a beam-hook con-
“ nection at their ends, and thereby prevent the chain from
“ twisting.”

“ For raising the smaller weight I use a portable arrangement,
provided with four rollers instead of a barrel, over and under
“ which to pass the hauling rope or chain, and to these rollers I
“ apply skew gearing for driving them. The rope I first pass
„ under one roller, then under the roller in the same line, then

" back to a roller situate under the first, round that roller, and
" forward to and over the fourth roller. By this means all
" tendency in the hauling chain or rope to slip is avoided."

" The same plan of V pullies and ropes or chains, as above
" described, is used for setting the apparatus in action."

[Printed, 4*d*. No Drawings.]

A.D. 1860, June 5.—N° 1378.

DE CARVALHO, Antonio Joaquim Pereira.—" Improve-
" ments in beams, applicable in the construction of bridges and
" other structures, and also for the floors and ceilings of
" houses."

The patentee says:—" For these purposes I form a chain of a
" series of links of wrought iron or other material; on the upper
" side of each link, or on a number of links, placed side by side,
" a block of wood or other material is fixed; these links are con-
" nected together side by side, and end to end, by rods passing
" through the ends of the links. The blocks mounted on the
" links are of such a size that their ends come in contact and bear
" the one on the other when the chain is laid out flat, so that if
" the ends of a chain, so constructed, be laid on two bearings
" with a space between them, the chain will remain as a bearer or
" girder spanning the interval between the bearings."

On beams thus formed " a paving may be laid," or for the
" pavement of bridges the blocks attached to the links of the
" chain, and which fit close together," may form the surface
of the pavement. Various modifications of the invention are
described.

[Printed, 10*d*. Drawings.]

A.D. 1860, July 12.—N° 1677.

GIBBS, Joseph.—(*Provisional protection only.*)—" Improve-
" ments in constructing submerged works."

This invention relates to the construction of the foundations of
bridges and other works under water, " by means of cassoons
" formed of distinct water-tight cells, which may be floated to the
" proper site and sunk by admission of the water, and the cells
" afterwards separately emptied of water and filled with concrete
" or other permanent building material, and also by means of a
" cylinder coffer dam, wider at the top than at the bottom."

These cassoons may each be formed of iron or other material, and of any convenient shape and dimensions, and so as to rise above water-mark when placed on its site, and the cells may be strengthened by a lining of brickwork laid in cement or asphaltum; or "removable stays may be used for the same purpose." The cassoons may be placed in contact with each other, or they may be some distance apart, and the spaces between them filled with rubble, or shingle, or bags of concrete, on which the superstructure may be wholly or partially raised. When placed upon a foundation of sand, or other material which is liable to be disturbed by the water, the cassoons may be furnished with feet at the corners, which will serve as piles, or groins may be placed "at right angles "to the face of the work."

In order to carry these cassoons to their places, a "transporting "cassoon" is used, which is made so as to separate into two parts when required, a space being left between these parts when united, in which the cassoon to be moved is deposited, the latter being furnished with joggles or shoulders, by which it is sustained on the edges of the other. The transporting cassoon, being filled with air, will float the other to the spot where it is required, and water being then admitted into the former it will sink and allow the latter to descend to the bottom, the two parts of the transporting cassoon being then separated and brought up by pumping air into them.

The "cylinder coffer dam," mentioned above, has "an outside "case of iron, wider at bottom than at top, lined with brick, "bonded and girded with iron; the lower edge is constructed "sharp, for penetration," and when the cylinder has been brought over the position it is intended to occupy, the gravel or material is scooped away inside and below it, so as to cause it to sink, when its interior may be filled with cement concrete.

[Printed, 10*d*. Drawings.]

A.D. 1860, July 21.—N° 1770.

TURNER, WILLIAM, and GIBSON, JOHN WILLIAM.—"Im-"provements in bridges."

This invention relates to "balanced rolling or sliding bridges," and by its use "the roadway or platform may be perfectly level, "instead of having a camber" as usual, and thus be available for supporting a line of railway, while at the same time the bridge may be closed or opened "without tipping or canting, or without "raising or depressing the ends."

The invention is described more particularly as applied to a bridge carrying a railway across a canal. The bridge is composed by preference of two longitudinal girders, connected by transverse girders or bearers upon which are mounted the rails of the railway, and below this structure, which forms the platform of the bridge, are guide and bearing rails, the latter resting upon rollers, certain of which are mounted in suitable supports upon the masonry at one side of the canal, while the others are mounted upon a wall or pier erected in the middle of the latter. The bridge is thus capable of being drawn along these rollers, and brought so far upon or over the land side of the canal where the first rollers are placed as to leave the space between the pier and the opposite side of the canal open. The rails of the railway on that side of the canal to or over which the bridge is drawn are, when the bridge is in position for use, in line with those on the latter, but in order to allow of the movement of the bridge these rails are, for a certain distance, mounted upon beams or girders which are carried by moveable supports so contrived that each beam may be turned on its "longitudinal axis," which has the effect of removing that portion of the railway carried by these beams so as to allow the bridge to be drawn back over them.

The beams carrying the moveable rails can be turned on their axes when requisite by the use of spanners mounted upon a shaft, and connecting rods passing therefrom to the beams, or by the use of curved racks and pinions, or other mechanical appliances, and they are retained in position when the rails are required for use by "saddle pieces" below them, and a locking bolt at each end which enters a hole in a casting placed to receive it. The beams may also be furnished with balance weights, and may, if desired, have upon them wooden sleepers for carrying the rails. At the ends of the bridge are stop pieces or brackets, which aid in keeping the whole structure steady when in use.

[Printed, 1*s.* 4*d.* Drawings.]

A.D. 1860, July 25.—N° 1803.

PILKINGTON, John.—"Improvements in means for protecting "and making water-tight exposed surfaces, such as railway "arches, bridges, roofs, and other structures."

This invention relates to the employment, for protecting and rendering water-tight exposed surfaces, of "heated bitumen or asphalte," with which such surfaces are coated, the bitumen or asphalte being then covered with "asphalted felt," or some similar material, and another coating of the heated bitumen or asphalte being laid upon such felt or other material. In some cases, "particularly when flat and even surfaces are to be operated upon," the materials may be applied "in a cold state; that is to say, manufactured in sheets or other forms, and afterwards laid down upon or affixed to the surface to be protected."

The patentee mentions the first coating of bitumen or asphalte as being about $\frac{3}{8}$ths of an inch, and that laid upon the felt as being about $\frac{5}{8}$ths of an inch in thickness, but states that these proportions may be varied.

[Printed, 4*d*. No Drawings.]

A.D. 1860, August 2.—N° 1864.

RYDE, John.—(*A communication from Frédéric Paul.*)—(*Provisional protection only.*)—"An improvement in apparatus applicable to turntables, swing bridges, cranes, and other machinery acting on a pivot."

The object of this invention is to "replace by a pivot with ball and socket the pivots and rollers hitherto applied to turntables of railways, swing bridges, cranes, and to every kind of apparatus moving on pivots by a very extensive circular plate, and thereby to diminish the resistance of all the above-named apparatus." This object is effected by fixing in the ground "a concave half sphere of cast iron, perfectly turned inside," the outside being strengthened by ribs. The bottom of this half sphere is hollowed out cylindrically to admit the introduction into it of a pivot, which is fixed at the bottom of a convex half sphere, which is made to fit into the concave portion of the apparatus, and the convex half sphere, which is strengthened inwardly by ribs, supports a cast-iron floor on which rails are or may be fixed, an opening in this floor, furnished with a "trap," allowing access to the interior of the convex half sphere "for the purpose of greasing, which is done by means of cups."

The details of the invention may be varied by using "ellipsoidal or lenticular" pivots instead of those mentioned above, or by placing "the convex sphere on the lower instead of the upper " part" of the apparatus.

[Printed, 4*d.* No Drawings.]

A.D. 1860, August 30.—N° 2099. (* *)

NEWTON, WILLIAM EDWARD.—(*A communication from Thomas Schofield and Robert Schofield.*)—(*Provisional protection only.*)— " Improvements in floating structures."

The object of this invention is " to produce a floating structure on " which the platforms or roadways of bridges, lighthouses, piers, " landing stages, and other structures may be supported above " water in places where the depth of the water does not allow of the " application of the pillars or fixed foundations commonly used for " such structures." It consists "in the employment for the " above purpose of a series of hollow globes or cylinders, which are " steadied by balance weights of a peculiar construction, and " which are secured to the ground by suitable chains and anchors. " These hollow globes or cylinders are also furnished with arms " or standards which extend upward for the purpose of supporting the roadway, platform, or other structure to be erected " above water. The hollow globes or cylinders are also provided " with valves and pumps for removing the water which may find " its way into the interior of the globes or cylinders."

[Printed, 4*d.* No Drawings.]

A.D. 1860, December 15.—N° 3084.

DAVIES, GEORGE.—(*A communication from Richard Montgomery.*)—" Improvements in building bridges, ships, or other " structures of iron or other metal."

This invention consists, in the first place, in the use or application for the purposes mentioned of beams made or constructed according to an invention forming the subject of a second patent, bearing the same date as the present patent, and granted to the present patentee, the invention for which such second patent was granted being also a communication from the Richard Montgomery mentioned above, such second patent being numbered 3086. The present invention also includes " certain details of " construction consequent upon and rendered necessary by the " employment of such beams for constructive purposes."

In applying the invention to the construction of a bridge, "each " span of the bridge consists of a certain number of systems of " arches supported upon suitable abutments."

Each of these systems of arches is composed of two curved beams, the curve of the lower having a longer radius than that of the upper beam. Each beam is made of corrugated metal, and according to the invention alluded to above, these corrugations being so arranged that at the ends of the beams, where they come together, they shall fit one into the other. "The ends of each " of these systems of arches rest on bed plates projecting from " the upper surface of the abutments, and these bed plates have " vertical projections, which fit into the lower side of the corru" gations of the arched beams, and blocks are also provided with " suitable recesses, so as to fit over the corrugations of the arched " beams. Through the ends of the arched beams, and through " the blocks and bed plates, bolts pass into the abutments. " Between the abutments and at equal distances apart, the two " arched beams are furnished with three or more blocks each, and " three or more bottom plates, the former being placed above the " upper beam, and the latter below the lower beam, and these " two and the two beams are connected together at each point by " bolts passing through them, and thus the two arches of each " system are united in such a way that their relative position is " unchangeable. The different systems of arches thus formed " are connected together by cross rails (also formed of corrugated " metal), and these cross rails rest with their ends on the flanges " of the lower arched beams immediately over the above-named " bottom plates, so that the same bolts pass also through them " and hold all together securely. These cross rails serve to " support the floorings of the bridge, while at the same time " they tend to steady and hold the said arches together."

In constructing ships according to the present invention "the " ribs or framework, deck beams, and other fundamental parts of " the hull of the vessel, are also constructed of corrugated metal " beams, made according to the invention above named, the " flanges of such beams forming the necessary margins by and " to which the outer planking or plates and deck planking are " fastened. The knee joints, by which the deck beams are " fastened to the ribs or outer framing, may be made of cast iron, " and must be formed with projections to interlock with the " corrugations of the beams. At those parts of the beams where

" bolts pass through filling pieces of wood or metal are to be
" employed to strengthen and stiffen the corrugated metal; the
" bottom of the hull may be supported and strengthened if
" desired by means of a longitudinal corrugated iron beam or
" keel. The entire hull may be divided transversely into separate
" water-tight compartments by means of vertical corrugated
" metal plates, the edges of which being fitted into the corru-
" gations of the beams and properly caulked, require no rivets or
" other means of fastening."

The second part of the invention, consisting, as mentioned above, of " certain details of construction," appears to relate in the case of bridges to the blocks, bottom plates, and bolts, and the corrugated cross rails by which the different parts of the structure are braced together, and in the case of ships to the " filling pieces " used at the parts through which bolts pass to strengthen and stiffen the corrugated metal, and also to an arrangement of corrugated cross beams by which the beams forming the frame of the hull are bound together, the latter having flanches to which the timber or plates forming the outside of the hull are fastened, and the cross beams having also flanges for the support of the deck beams, these cross beams also aiding in the support of the plates or bulkheads forming the water-tight compartments when such are used.

[Printed, 2*s*. 4*d*. Drawings.]

1861.

A.D. 1861, January 12.—N° 93.

GIBBS, Joseph.—" Improvements in constructing submerged
" works."

This invention relates to constructing bridges, breakwaters, piers, and other works of a similar nature.

One part of the invention consists in the employment, in forming the foundations of bridges and other structures, of cassoons constructed with a number of water-tight cells in the interior, which cassoons may be floated in an empty state to any position in which they are required, and then sunk by the admission of water into the cells, such water being afterwards pumped out of the cells, and the latter filled with concrete or other building material, upon which the superstructure of the bridge or other erection may be raised. The cassoons may be composed of sheet iron or other suitable material, and of any suitable form, and the cells may be strengthened by being lined at the sides and bottom with brick or other material laid in asphalte or cement, or they may be strengthened by "removable stays." Or the cassoons may themselves be composed of brick or other hard material, bonded with hoop-iron ties, and having a wooden or an iron foundation plate at the lower side. Each cassoon should "rise " above high-water mark when placed on its site."

These cassoons may be used in any number that may be required, and either placed close together, or arranged at some distance asunder, and the spaces between them filled up with rubble or shingle, or with bags of concrete, which will ultimately form a solid mass. And when such cassoons are placed upon sand or shingle, which may be moved by the action of the water, they are furnished with "feet," which will project down into such sand or shingle and retain them in their places; or groins may be placed at right angles to the face of the work for the same purpose.

These cassoons may be deposited in their places by the aid of a floating derrick, but when their weight is great, a "transporting " cassoon" is used, which is constructed so as to separate into two parts, there being a space between these parts for the reception of the cassoons to be moved, and the latter being furnished with shoulders or projections by which it is sustained on the inner sides of the transporting cassoon while needful, the latter being filled with water when the former has been brought over the spot on which it is to be deposited, by which means both are sunk, the transporting cassoon being then divided, so as to free its parts from the other, and such parts being next raised by forcing air into them. These parts are kept together when in use by latticed girders, with which it is provided.

A cassoon of this description may be used as a coffer dam, being then formed of such size as to admit of the construction of a pier or other structure within it. In this case the cassoon is furnished with a floor, which is attached to it by screws before it is sunk, and the pier or other structure is erected upon this floor, which is then disengaged from the cassoon and the latter removed. Such a cassoon may be open at one end, such openin being closed by piles to the requisite extent while the work is proceeding.

The invention also includes the use of a "cylindrical cellular "coffer dam" for the foundations of bridges and other structures, this coffer dam consisting of an outside case of iron or wood, wider at the top than at the bottom, lined with brick, and bonded and girded with metal, the lower edge being sharp, so that when placed in the position in which it is required, and the sand or other material is scooped from inside and below it, the weight of the whole will cause it to sink into the sand or other material, after which the interior may be filled with concrete in the usual manner.

[Printed, 10*d*. Drawings.]

A.D. 1861, February 11.—341.

NEWTON, WILLIAM EDWARD.—(*A communication from Thomas Schofield and Robert Schofield.*) — "Improvements in floating "structures."

"The object of this invention is to produce a floating structure "on which the platforms or roadways of bridges, lighthouses, "piers, landing stages, and other structures may be supported "above water in places where the depth of the water does not "allow of the application of the pillars or fixed foundations "commonly used for such structures."

"The invention consists in the employment for the above pur"poses of a series of hollow globes or cylinders, which are "steadied by balance weights, which are secured to the ground "by chains and anchors. These hollow globes or cylinders are "also furnished with arms or standards, which extend upwards "for the purpose of supporting the roadway, platform, or other "structure to be erected above water. The hollow globes or "cylinders are also provided with valves and pumps for removing "the water which may find its way into the interior of the globes "or cylinders, so that their buoyancy may be maintained."

The globes or cylinders do not float on the surface of the water, but are confined below it at the depth of several fathoms, so as to place them out of the influence of the waves, and the chains are so contrived, either by being constructed of "tubular links," or by being provided with small buoys, "as not to hang as dead "weights" on the globes or cylinders, such chains being attached to arms projecting from them. Each globe or cylinder is also provided with a "steadying or ballast rod," which projects downwards from it, and consists of a metal tube surrounded by a wooden casing, and having a heavy ball at the lower end, chains proceeding from these ballast rods to anchors fixed in the ground. These chains proceed from hooks inside the tubular rods, and the tubes of these rods are continued upwards through the globes or cylinders to the bridge or structure above water, and are furnished with pistons and valves, by which they are made to serve as pumps for the extraction of water from the globes or cylinders; a float connected to each pump rod being made to operate upon an "alarm or index" on the bridge or structure when the water in the globe or cylinder to which that rod belongs has reached a certain quantity. The standards which project upwards for the support of the bridge or other structure are suitably braced together, so as not only to sustain such bridge or structure, but also to preserve the relative distances of the globes or cylinders from each other.

[Printed, 8*d.* Drawing.]

A.D. 1861, February 25.—N° 482.

CLARK, George.—"An improved method of connecting and "fastening together blocks, plates, or slabs of wood, metal, or "any other material."

This invention consists in connecting and fastening together plates, or blocks, or bars of any required material by cutting into one of their surfaces grooves of dovetail section, and then inserting into such grooves rods or bars, or "tongues," of a section corresponding therewith.

In illustrating the invention the patentee describes oblong blocks of material, resembling bricks in form, as having each two grooves passing across one of its broader surfaces, such blocks then being laid or placed so as to break joint, when the insertion of the "tongues" will bind the whole together. He states, however, that the invention is applicable to "pieces of metal, wood, or "other material, whatever may be their shape or designation," and that the invention may be adapted, among other purposes, to the construction of bridges, but he does not set forth any particular application of the invention thereto.

Blocks of material may thus be combined together to form a pavement, and also to form cellar flaps, wainscoating, flooring, ceilings, billiard tables, mosaic or tesselated work, and other structures. If desirable, a number of blocks or plates thus combined may be united to the surface of another body by means of bolts, which are inserted into the dovetail bars or tongues, and, passing through the body to which the blocks are to be attached, are furnished with nuts which secure the whole together, a "backing" being also included within the nuts if necessary. An arrangement of this kind is described as being suitable for attaching armour plates to the sides of ships, the tongues in this case being each connected to a broad bar or plate through which bolts are passed, instead of such bolts passing through the tongues themselves, a "back support" of wood or iron being placed inside the skin of the ship as a "bearing plate" for the nuts.

[Printed, 8*d*. Drawing.]

A.D. 1861, March 14.—N° 633.

CLARK, William.—(*A communication from Mathieu Castay.*) —"Improvements in bridges."

According to this invention each side of a bridge is composed of three longitudinal girders, placed one above another, and united by diagonal bars or girders and vertical rods. The longitudinal girders "are of laminated or sheet iron for metallic bridges, and of "wood for wooden bridges," and they are united by diagonal bars or girders and vertical rods. The longitudinal girders are of the "twin" construction, being formed of two sides having ribs or flanges projecting outwards at top and bottom, while the diagonal beams have flanges on each side, and are provided with "boxes" at the points of contact with the longitudinal girders and with each other, to prevent them from being strained at those points in consequence of their flanges only forming such contact, the whole being united by bolts, and the spaces between the twin girders which are not occupied by the ends of the diagonal girders being filled up by "sections of ties of H form." The diagonal girders themselves may be formed of wrought or cast iron, or laminated iron. The platform which supports the road is composed of planking, which rests upon the flanges of either the middle or the lower longitudinal girder, these girders themselves being bound together below such planking by diagonal braces strengthened by "struts" proceeding from the girders, and longitudinal bearers running along these diagonal braces under the platform. In order to strengthen the bridge a cable is passed across it and over a pulley at each end, this cable being connected by its extremities to the girders, and also by other cables and by connecting rods attached thereto. Or instead of a continuous wire cable, "pitch chains" may be used at those parts which pass over the pulleys, for which toothed wheels may then be substituted. The cables and rods may be adjusted in tension by screws suitably arranged, or by moving the bearings of the wheels or pulleys outwards, and if necessary more than one cable may be used. In the case of bridges of more than one span a cable or cables will pass from one pier to another of each span. In some cases, instead of three longitudinal girders, two only are used on each side the bridge, an upper and a lower one, these being connected by vertical or nearly vertical ties or rods arranged in pairs to allow the passage of the strengthening cable or cables between them, and the structure being further strengthened by diagonal bars connecting the upper and lower portions of the vertical or nearly vertical rods with the girders.

The details of the invention are described at some length, and under various modifications.

[Printed, 1*s*. Drawings.]

A.D. 1861, March 16.—N° 667.

JENKIN, Fleeming.—" Improvements in the construction of " bridges."

Before describing the details of this invention the patentee mentions that heretofore, where rigid arched ribs have been used for bridges, it has been found necessary to limit the compression of such ribs (considered as equilibrated arches) to a strain much below what the materials would bear safely, in order to provide strength to meet extra strains caused by flexure when the arch is not equilibrated, and that it is very difficult to calculate these extra strains.

He then states that according to this invention " a flexible " arched rib is used, which is braced or connected by struts and " ties to an upper rib placed at a sufficient distance above it to " form with it an inflexible frame wherein the lower arched rib will " be in a state of compression, thrusting against abutments at " points which support the weight of the bridge. For this pur- " pose it is preferred to employ a polygonal flexible pin-jointed " arched rib in place of the rigid arched rib heretofore used. The " upper rib is connected to the pin-jointed angles of the polygonal " arched rib by means of struts and ties or bars, which act alter-

" nately as struts and ties. The upper rib may be continuous, or " it may be in parts and pin-jointed. The struts are pin-jointed " at both ends, and such is usually the case in regard to the ties, " but in some constructions their flexibility will render such " jointing unnecessary. By this construction a jointed frame is " produced, each member of which is subject to a strain in the " direction of its length only, consequently the sectional area of " each member or part of the structure can be readily and exactly " calculated and proportioned to the maximum strain which it " will have to bear under any distribution of the load. The upper " rib, strengthened to meet a transverse strain, may also be used " to bear the roadway and load between each strut." Instead of the lower arched rib being a pin-jointed polygon it may be a continuous rib, which must be comparatively very flexible in its whole length; but the lengths into which it is divided by the connection of the struts and ties must each be so stiff and rigid as to act as a separate member of a polygonal arched rib: the pin joints may in this case be omitted. "In the frame thus con-" structed each member, besides the chief strain in the direction " of its length, is subject to a transverse strain, which is compara-" tively very small."

[Printed, 8*d*. Drawing.]

A.D. 1861, May 11.—N° 1202.

JONES, George Fowler, and JONES, James.—"Improve-" ments in the form and construction of ships or vessels, and of " arched ribs for roofs, domes, and bridges."

This invention consists, mainly, "in making the vertical section " of vessels of war, such as gun boats or floating batteries, of an " oval form, such form of construction giving to all parts the " greatest amount of strength, and presenting a large receding " surface to the action of shot discharged against it, and this form " of section being continuous the gun deck is under a domed " shot-proof cover, thus protecting both the men working the " guns, and the latter from exposure on an open deck." The form of the oval may be varied as required, either to obtain "a " flatter or more arched deck cover," or otherwise, as may be required.

The details of the invention are set forth at some length, and under various modifications, the patentees claiming particularly, as *of their invention*, the employment, in the construction of vessels of war, of "box plates with or without ends," and connected by means of side flanges, "which being on the inside they are easily " got at for the purposes of repair." "Double plates" are also described as being used, these being either placed close together or some distance apart, in the latter case wood, or some other elastic material being, if desirable, placed between them. These plates may be " made of the best wrought iron or of soft malleable " steel, or both united."

Several applications of the invention to the construction of bridges or "arched ribs" are set forth, in some cases an arch being formed of " box plates" only, while in other cases the arch is composed of box plates united together or strengthened by " box plate ribs;" either single or double box plates being used according to circumstances. For these purposes the plates may be " either of cast or wrought iron or of cast-steel."

[Printed, 1*s.* 4*d.* Drawings.]

A.D. 1861, May 30.—N° 1354.

OUDRY, Alphonse.—" Improvements in the construction of " suspension bridges."

This invention consists " in constructing suspension bridges in " such manner that when one portion of the platform or roadway " is subjected to a greater burthen than other portions, it does " not become distorted or put out of shape, neither is the " structure itself liable to oscillate."

In order to produce these effects, two suspension chains are used on each side of the structure, both of these chains being connected to or proceeding from the same points of suspension, but being provided with bars which are placed diagonally between them, in such manner that in passing from one pier or point of suspension to the middle of the bridge, one chain is made to describe a curve of less radius than the other, the two crossing at the centre and then proceeding in reversed order to the other pier, that chain which in the first half of their course described the curve of less radius now proceeding in a curve of greater radius than the first. The patentee states that by this arrangement the surplus strain upon either chain or cable will be communicated to the other, by which means the strain will be equalized. From these chains the suspending rods descend to the platform of the bridge, these rods not being perpendicular, but inclining inwards towards the platform, the width of which is less than the distance between the chains above; and in order to give greater rigidity to the structure the suspension rods are themselves connected by diagonal ties, while the platform itself is of the "lattice" construction, each side of the platform consisting of three horizontal bars placed one above another, and connected to each other and to the suspending rods by numerous short diagonal and vertical rods. In some cases, in order to obtain the greatest possible amount of rigidity, the suspension rods are further connected by bars and ties passing across the structure at a sufficient height above the platform to offer no obstruction to the traffic passing over the bridge, but where the distance between the platform and the suspension chains is very short, these cross bars and ties are placed below the platform. If desirable, four of the double suspension chains may be used, two over the middle portion of the bridge, and one on each side, the suspension rods from the outer chains inclining inwards to the sides of the platform, and those from the others inclining outwards thereto, the suspension rods being further united by cross bars and ties. The details of the invention are minutely described.

[Printed, 10*d*. Drawing.]

A.D. 1861, August 19.—N° 2054.

COLBURN, ZERAH. — (*Provisional protection only.*) — "Im-
" provements in the construction of suspension bridges."

This invention consists in substituting for the ordinary flexible iron or other chains, or wire cables, used in suspension bridges,
" continuous and rigid wrought-iron or steel suspending bars,
" flanged or otherwise stiffened, the axis of each of which is
" curved, as nearly as may be, to the catenary curve correspond-
" ing to a wire of uniform diameter and weight, and suspended
" from two points so as to have the same span and versed sine."

From these bars the roadway, either with or without "stiffening
" trussing," is suspended in the usual manner by vertical or diagonal rods or wires. "The ends of the curved suspending
" bars would be attached at the tops of the two supporting towers
" at or next to the ends of the bridge, to back chains of the
" ordinary kind, or to half bars of a construction and section
" like the main suspending bars already described, such half bars
" or back chains being anchored in the ground in the usual
" *manner.*"

The objects of the invention are to avoid the undulation to which ordinary suspension bridges are liable, and also to secure “ the most advantageous application of material,” the “ sus- “ pending bars ” being subjected to “ tensile strains only,” and not liable to “ buckling ” or “ lateral failure.”

[Printed, 4*d*. No Drawings.]

A.D. 1861, August 22.—N° 2102.

BAINES, William.—“ Improvements in the construction of “ girders, frames, or other apparatus, fixed or moveable,” and “ certain peculiar forms or sections of iron used therein.”

“ In the forms or sections of plates used in the construction of “ these frames or compound girders, one part of each is male and “ another part female; by bringing these parts together they “ become inserted, and being secured by bolts or rivets, effect a “ vertical union and continuous bearing, branching or extending “ where required,” one part of the invention relating to railway turntables, and consisting in bending and forming the plates into suitable parts or segments, and securing them in their respective places by bolts or rivets, “ thus constituting one entire frame “ forming its necessary cross girders which can be produced to “ suit any angle for any number of roads upon the table.”

Various modifications of the invention are described. In one case a number of plates or bars are placed parallel to and at a short distance from each other, each plate having upon it certain single tapering projections, and also double projections, or projections close together and having between them tapering spaces, the single projections of one bar entering into the spaces between the double ones of the next, and the whole being drawn tightly together by bolts passing through the bars. In other cases semicircular projections from one bar enter correspondingly formed recesses in another, while in another arrangement the bars are united by separate pieces passing from recesses in one to recesses in another, these recesses and projections or pieces being capable of great variation in form. And plates thus united are described as applicable to the formation of different kinds of girders, including both truss and lattice girders, in some arrangements the plates being so “ bent and formed branching to and from ” as to constitute a structure somewhat resembling network.

In the construction of a turntable a number of plates are so bent that they form a square, having diagonals crossing each other from corner to corner, and with its sides elongated and connected to a circle surrounding the whole, this structure being furnished with a suitable platform.

[Printed, 10*d*. Drawing.]

A.D. 1861, September 24.—Nº 2380.

SEDLEY, ANGELO JAMES.—" Improvements in constructing " bridges and viaducts."

This invention " consists in combining, as hereafter explained, " the principles of construction employed in the formation of " tubular and suspension bridges and viaducts in such manner " that the suspension shall form part of the tubular construction. " And in place of having recourse to the use of centerings and " the other means heretofore employed or resorted to in constructing and raising tubular bridges and viaducts," part of the invention consists " in constructing tubular bridges and viaducts " on an embankment or raised way, or on a suitable surface or " way on the margin of the river or other water or valley across " which a tubular bridge or viaduct is to be placed, preferring to " construct such raised or other way with suitable rails or trams, " in order that when the tubular bridge or viaduct has been constructed inland, it may with greater facility be run out to the " distance required, either to span the water or valley, or to " partly span it, in those cases where a bridge or viaduct is to be " in two parts to meet and be connected intermediate of the " width of the water or valley; and such bridge or viaduct, or " the two sections thereof, having been built inland, are then " moved outwards to the extent desired, sufficient length of the " structure in each case remaining inland to counterbalance the " part projecting beyond the pier;" although the part left inland need not in itself be of equal length and weight with the part projecting beyond the pier, but may have weights laid thereon, or be anchored to the way or surface inland. Another part of the invention consists in constructing bridges or viaducts " of two or " other number of tubular girders, by preference of rectangular " section," which are " connected together by preference with " cross hollow girders of rectangular sections, and from the upper " parts of the structures, where they come over and are supported " by a pier, suspending bars are employed which descend in inclined directions towards the bottom of the structure in either " *direction*, that is, to the part of the structure projecting from the

" pier, as well as to the part of the structure inland, and such
" suspending bars have fixed to them the plating of which the
" sides of the girders are constructed, and also the upright angle
" irons of the structure to which also the side plating is rivetted;
" and in order that the sides and other parts of the tubular girders
" where they rest on and are supported by a pier may be capable
" of bearing the strain consequent on the use of suspension bars
" in the manner described, the parts of the structure which come
" over a pier are suitably strengthened. By thus applying suspension
" bars (which may be of any desired section) in the structure
" of tubular girders, they will perform the office of the
" catenary suspending chains of suspension bridges, whilst the
" upright angle irons and side plating will act as suspending rods.
" In some cases several of such suspending bars may be employed,
" the succeeding ones passing to a greater and a greater
" distance from the part of the structure where it is supported on
" a pier or other support, so that the first suspending bar will
" descend from the upper part to the lower part of the structure
" more quckly than the next and the next, and consequently their
" lower ends will be more and more distant from the pier." A
bridge or viaduct made in two parts will have such parts suitably connected at those ends which form the centre of such bridge or viaduct, "where their construction is such as to require it," and in order to allow for expansion and contraction the outer ends may rest upon rollers. The roadway or roadways may be constructed either upon or inside the girders.

[Printed 10*d.* Drawing.]

A.D. 1861, December 24.—N° 3226.

COCHRANE, John.—" Improvements in apparatus employed
" in sinking cylinders and open coffers for forming foundations
" under water."

According to this invention, when sinking cylinders or coffers,
" there is formed at the upper part a chamber, with an opening
" into it from the outer atmosphere, and also an opening into the
" coffer below. Both these openings are arranged as heretofore,
" to be closed air-tight, and are for the passage of the workmen
" into and out of the cylinder or coffer," the latter being composed
as usual of suitable lengths, united by means of internal flanges.
" The buckets to carry up the earth or materials as they are excavated
" are caused to ascend and descend in a pipe or pipes

" which descend from a point above the upper closed chamber " down to and so as to dip into a recess or well, if desired, where " the work is being carried on. The descending pipe is made in " lengths corresponding with the lengths of the cylinder or " coffer," "and is of such diameter as to allow a bucket to " pass up and down freely, leaving a space all round for the " free passage of water." By these means, when the water is driven out of the cylinder or coffer by compressed air, for which suitable provision is made, it will remain in the pipe, "and will " stand at or about the same level as it does outside of the cylinder " or coffer. The brackets are raised and lowered by any suitable " mechanism outside of the cylinder or coffer; consequently the " only workmen who will be working in a compressed atmosphere " will be those who are digging or removing the earth or materials " at the bottom of the coffer, and they will, when they have filled " a bucket, place it under the lower end of the pipe and attach it " to a chain or rope, when the full bucket will be raised up " through the water in the pipe."

In using this apparatus, after the cylinder or coffer and inner pipe have been placed in position, the passage between the upper or air chamber and the cylinder below is closed, and compressed air is driven down into the latter by suitable pumping apparatus outside the chamber, such air proceeding through a tube passing through the bottom of the chamber and furnished at its lower end with a valve. When this compressed air has forced the water in the cylinder or coffer to descend therein, and ascend in the inner pipe, a man descends into the air chamber from above, closing the passage behind him, and then opens a cock which forms a communication between the air chamber and the cylinder, thus allowing compressed air to fill that chamber also. He then opens the passage leading into the cylinder and descends to the bottom of the latter, and first forms a well or excavation under the inner pipe; then proceeding to fill a bucket or tub with earth, and placing such bucket or tub under the pipe he connects it to a rope or chain which has been lowered inside the pipe from a windlass above, and by which it is drawn up to the top of the apparatus. Thus the work proceeds until it is necessary to attach another length to the upper end of the cylinder or coffer, when the man ascends into the air chamber, and having closed the passage between that chamber and the cylinder he opens a cock in the side of the chamber and discharges *condensed* air therefrom, after which the passage leading out of the air chamber to the exterior is opened and the cock first named is opened also, which allows the condensed air to escape from the cylinder. The air chamber is then removed, and the additional length of cylinder having been added, the air chamber is replaced upon that, and the work proceeds as before. The inner pipe has the lower length so formed as to slide upon that above it, this enabling that pipe to adapt itself in length to the varying heights of the cylinder or coffer, and the air chamber has, in the door or flap which is used to close the passage with it from the outside, a glass lens or bull's eye, through which light is admitted into that chamber.

[Printed, 1*s.* 4*d.* Drawings.]

A.D. 1861, December 27.—N° 3240.

TURNER, William, and GIBSON, John William.—" Im- " provements in rolling bridges."

In this invention the platform or roadway of the bridge is constructed by combining two or more trussed girders, the under sides of which form longitudinal rails, which rest upon rollers mounted upon a pier or wall placed about midway of the length of the bridge, or on the tail pit side of the opening spanned by such bridge; a rack, or racks, being also fixed to the under side of the bridge, and a pinion, or pinions, with other suitable gearing, being so arranged as to operate upon such rack or racks when requisite, and so move the platform to and fro as required.

An arrangement is described in which the tail end of the bridge rests upon toothed bearing wheels which are in gear with the racks on the under side of the platform, these toothed bearing wheels being mounted upon fulcra carried by a toothed sector placed upon a horizontal shaft, and in gear with a pinion, which, on being turned, so moves the sector and bearing wheels as to lift up that end of the bridge preparatory to the whole platform being moved backwards, which is then effected by other gearing acting upon the bearing wheels. This sector and its adjuncts the patentees denominate the "counterbalanced tilting gear." The rails under the platform are so curved and inclined that as the platform is drawn back it also descends, and when restored to its first position, by reversing the action of the gearing at the tail end of the platform, the other end of the latter is sustained and kept in its place by "locking cams," which are capable of being moved into different positions by gearing. These arrangements may be varied by placing the "moving gear" at "the quay line or fore "end of the pit;" or by using such moving gear at both ends of the bridge.

[Printed, 10*d*. Drawing.]

1862.

A.D. 1862, March 18.—N° 751.

DUNN, THOMAS.—"Improvements in the construction of "bridges, roofs, houses, and other structures."

The Specification of this invention is of great length, and is accompanied by one hundred and four sheets of drawings. The first part of the invention which requires notice here relates to the construction of a lattice girder bridge, which is "intended for a "railway with a double line of rails." Each side of this bridge is composed of two ranges of latticework, one above the other, and the diagonal bars of the upper forming a much greater angle with the perpendicular than those of the lower range. The upper rib of each side of the bridge is composed of "Barlow rails" (which are hollow rails, in which the lower portion of each side forms a kind of flange), these being rivetted upon T rails, to the centre ribs of which are rivetted the upper ends of the bars forming the upper range of latticework, the lower ends of these bars being connected to the middle rib of another T rail, and the lattice itself being again rivetted to a third T rail, to the middle rib of which the upper ends of the bars forming the lower range of latticework are fastened, the lower ends of these bars, again, being connected to the middle rib of a fourth T rail, and the latter to another Barlow rail. The bars of the latticework are all composed of double-headed or beaded rails, the beading being cut away at the joints and crossings, in order to relieve the strain on the rivets by which the rails are connected to each other and to the T rails. A horizontal bar passes along the intersections of the upper lattice bars. Between the two sides of the bridge is a central portion, composed of an upper and a lower beam and a single range of latticework, the sides being connected thereto by diagonal stays, and certain cross bars, which pass from side to side of the bridge, resting upon this central portion and sustaining a wooden floor which carries the railway.

Another part of the invention consists in supporting the four lines of rails composing a railway upon four separate lattice girders, each girder consisting of an upper and lower beam formed of two thicknesses of plate iron, having angle irons rivetted thereto, and the diagonal bars forming the latticework being rivetted at each end to these angle irons. There are here two single parallel ranges of latticework to each girder, and the bars of the latticework are "interlaced" with each other, "like basket- " work," in order to "relieve the rivets of a part of the strain;" the structure being further strengthened by diagonal stays between the two ranges of latticework of each girder, and other diagonal bars passing from one girder to another.

Another railway lattice girder bridge is described, in which two main girders are used, which are constructed in the following manner:—The top rail is formed of ordinary Barlow rails, rivetted to three plates, to which are also rivetted two angle irons, the lower part of the girder being composed of a Barlow rail, four plates, and angle irons, all rivetted together; there being secured between the angle irons the ends of the lattice bars, which are interlaced and rivetted together. The main girders are connected by transverse girders, which are also formed of an upper and a lower plate, with angle irons and latticework; and the roadway, which consists of two thicknesses of planks placed diagonally, rests upon transverse girders, and supports longitudinal sleepers and the rails of a railway, the bridge being further stayed by diagonal tie-bars.

According to another arrangement the sides of a bridge are composed of hand rails, T rails, latticework, and certain other T rails, which are secured to wood planks, these latter being attached to the ends of other planks forming the roadway which supports the rails of a railroad. The roadway itself is supported by double girders, each of which consists of two plates and two angle irons, to which are secured the upper ends of certain double-headed bars, the lower ends of these bars being secured to angle irons rivetted to certain plates. The lattice bars are stayed by angle or T bars, and the angle bars are connected by diagonal stays, the ribs on the double-headed bars being "partially cut " away or indented where they cross," the shoulders thus formed abutting against each other and relieving the rivets "from the "strain."

In another arrangement of bridge the sides of the latter are formed of latticework, the bars of which interlace with each other, the latticework being attached above to angle irons which are connected to a hand rail, and below to other angle irons which are secured to beams or girders, each of which consists of "a plate "of iron or steel surrounded by an angle iron." These girders bear upon and are supported by four lattice girders, composed of top and bottom angle irons, and double-headed lattice bars, these bars being strengthened at their intersections by plates secured thereto by rivets.

Another lattice bridge is described, in which the lattice bars are composed of double-ribbed rolled iron or steel, with intermediate plates, the piers being made of "angle-iron corners with interlaced "latticework between;" while in another case the girders are composed of plain flat bars interlaced at the crossings, the piers being "made of double-ribbed iron or steel with strong angle-iron "framing."

Other arrangements of lattice girder bridges are described, in some cases the lattice beams consisting of three thicknesses of plate iron rivetted together and to a T bar, while in other cases the bridge consists of four lattice girders, composed of longitudinal plates, angle irons, and flat bars, such girders being connected by transverse beams and diagonal stays. Other arrangements, again, are described in which both "platework" and "latticework" are used, some of these arrangements constituting tubular bridges. In one case the bridge is composed entirely of "rolled-iron "plates, strengthened by top and bottom angle or other suitable "iron, and by double-ribbed rolled-iron uprights." Several arrangements suitable for girder bridges are also described, in some cases the side plates of the girders being strengthened by ribbed bars placed both vertically and diagonally, and in other cases by both ribbed and plain bars placed diagonally, the ribbed bars slanting in one direction and the plain bars in the other. One bridge of this class is described in which the girders are supported by tall pillars, two of which rise to a considerable height above the girders, and are connected at the upper ends by a chain or wire rope, bars passing backwards from the upper parts of these pillars to "land ties," and diagonal bars descending therefrom to act as stays to the girders.

A foot bridge is described as being suitable for passing "over "a crowded street," this bridge being constructed with side girders of interlaced latticework, or "of any improved construction as "herein described," stairs being provided for giving access to the bridge.

A mode of erecting a bridge without the use of scaffolding is described in which the piers are first erected, and those portions of the bridge which are to be united to them then secured thereto, these portions then serving to support a travelling crane, which carries forward the next portions to be united to the first, and these then serving to bring forward other portions, and so on in succession, the work being commenced at each side, and completed by joining the parts so put forward when the centre of the bridge is reached, temporary suspension rods being used to stay the structure until the work is finished. In adopting this mode of constructing a lattice girder suspension bridge the first lengths of the upper bars are temporarily supported by tie bars, and the rest of the structure gradually united thereto; or the horizontal bars of such a bridge may be commenced first, and, being temporarily supported, may sustain a travelling crane and other apparatus by which the rest of the structure may be brought forward and added thereto.

One form of bridge is described in which there is no "planking," or solid roadway, there being only rails upon which a carriage may run, such carriage being constructed of latticework, and being propelled by a man within it turning a handle connected with wheelwork which acts upon a rack laid in line with the rails.

Included in the invention are also several arrangements of suspension bridge adapted for "light traffic," these all consisting of a chain or wire rope, or chains or wire ropes, passing across the space to be traversed, and sustaining a carriage or platform furnished wtih a wheel or wheels from the axes of which it is suspended, such wheel or wheels travelling along the chain or rope, or chains or ropes. Other forms of suspension bridge are described in which latticework girders are sustained by bars descending from chains in the usual manner. A swing bridge is also described of which the sides are of sheet iron, strengthened by double-ribbed uprights and cross bars, there being near one end of the bridge a turntable, and at the other end a ram or plunger which, when the bridge is in position for use, rests in a kind of socket, hydraulic power being applied thereto when it is necessary to raise that end of the bridge previous to its being turned aside. A double swing bridge is also described in which two piers or pillars each support a turntable carrying one half of the bridge.

The modifications of which the various parts of this invention are described as being susceptible are almost innumerable, although many of them resemble each other so closely that they amount substantially to the same thing. The invention includes the use of iron and steel of various sections, and bars, plates, and other articles of almost every conceivable form, and involves a multitude of details which will only be understood with the aid of the drawings annexed to the Specification. In addition to the construction of bridges the invention is described with relation to the roofs and other parts of buildings, gates and fences, fountains, boat and ship building, armour plates for vessels of war, moveable land batteries, railways, and other structures; but many of the details set forth are of such exceedingly trivial character that it is difficult to understand why they were introduced into the Specification at all.

In addition to structures composed of metal, certain "compound "beams" are described as consisting of two "triangular timbers," and applicable, among other purposes, to the construction of a "road bridge," the compound beams being connected by a rectangular "or other shaped beam," supporting joists upon which the roadway of the bridge rests. "Compound diagonal "trusswork" beams are also described, but no particular application of these beams to the construction of a bridge is set forth.

A design for a "footway above the parapets of London bridge, "or other crowded bridge," is included in the Specification, as also a design for a room for "reading," or other purposes, to be supported on pilasters formed of latticework, over Southwark bridge.

[Printed, 2*l*. 13*s*. Drawings.]

A.D. 1862, April 10.—N° 1025.

BLACK, Alexander.—(*Provisional protection only.*)—"Improvements in swing bridges adapted for crossing lines of rail- "ways and other ways."

According to this invention the bridge is so constructed "as to "*close* or fold up into a very small compass." Two iron pillars or standards are fixed into the ground, out of the central line of the railway or other way, one being to the right hand and the other to the left of such central line, or diagonally, the upper end of each pillar having therein a hole or recess in which a pivot or spindle is adapted to revolve. These pivots carry cast or wrought iron girders equal in length to the space to be crossed by the bridge, the ends of these girders being supported by masonry when the bridge is in position for being used, and the girders by transom ties or cross pieces hinged thereto, a longitudinal recess being formed in the inner side of each girder for the reception of the transom ties when the bridge is moved to allow of the passage of a railway train or other object, which is done by moving these girders on their pivots, they and the transom ties then acting in a manner similar to the well-known parallel rule used by draughtsmen, and the girders thus being brought close together and in a line with the railway or other way, so as to offer no obstruction to the passage of the trains or vehicles thereon. The floor of this bridge is composed of plates hinged to the inner edges of the girders, which plates rest upon the transom ties when the bridge is in use, but are turned up so as to rest against handrails affixed to the girders when it is necessary to move the bridge out of the way as already mentioned. This construction of bridge is mentioned as being suitable for use in crossing from one platform to another of a railway station, as well as in other situations.

[Printed, *4d.* No Drawings.]

A.D. 1862, April 14.—N° 1062.

PEYTON, Edward, and BATHO, William Fothergill.—" Improvements in angle iron, applicable to metallic bedsteads, " roofs, bridges, and other similar purposes."

This invention consists in manufacturing angle iron " with " corrugations," for the purpose of giving to it " additional " strength or stiffness," and enabling a " lighter bulk of metal" to be used than would otherwise be requisite, " thus combining " strength with lightness of material, and giving an improved " appearance to the object constructed with it, such as metallic " bedsteads, roofs, bridges, or similar constructions."

This angle iron " may be made of any required dimensions, and " have any suitable number of corrugations."

[Printed, *6d.* Drawing.]

A.D. 1862, April 29.—N° 1251.

CLARK, Edwin.—(*A communication from Johann Fillunger.*)—
" Improvements in arches."

This invention consists "in the peculiar arrangement and con-
" struction of arches for bridges, roofs, and similar structures,
" more particularly when the openings to be arched are of con-
" siderable span, these arches being composed of bars or plates
" arranged in the form of a single or a double series of tri-
" angles."

" According to this invention the two segments forming the
" intrados and extrados of the arch or rib are placed at some
" distance apart, and are connected by diagonal braces, which
" divide the space between the segments either into a single or a
" double series of triangles, the double series being applicable
" to arches of large span, in which case one set of diagonals
" would intersect the other, and thus reduce the distance between
" the points of support. The segments may be formed of bars
" or links connected by pins or rivets, which also connect the
" diagonal braces; or the arch may be constructed of triangular
" frames bolted or rivetted together."

[Printed, 8*d*. Drawing.]

A.D. 1862, May 7.—N° 1372. (* *)

MARCHAL, Désiré, and DE WIART, Adrien Carton.—
" An improved method of preventing the destructive effects of
" vibration or jar on the permanent way of railways, and on the
" wheels, axletrees, and other parts of carriages, and the working
" and other parts of machinery liable to shocks."

The invention consists in the application to those parts which are liable to shocks of a band, plate, washer, or lining of lead, tin, zinc, copper, or an alloy of these metals, or either of them. It is applicable to the rails and chairs of the permanent way of railways, to the axletrees of engines and carriages, to various parts of machinery, and to the bearings of iron bridges. " By thus
" interposing a soft and inelastic metal between two hard metals
" or surfaces, the injurious effects of concussion will be greatly
" reduced."

[Printed, 1*s*. Drawings.]

A.D. 1862, May 26.—N° 1567.

DE BERGUE, Charles.—(*Provisional protection only.*)—" Improvements in iron framing applicable to supporting coverings " or surfaces intended to resist blows or pressure."

This invention embraces "the constructing iron framework of " two series of ribs or beams, one series of them shaped and " applied to give the desired sections or form in one direction, " and others shaped and applied crossways to the first series to " give the desired sections or form in a cross direction, and the " two series being rivetted or connected together and further " strengthened by struts, or ties, or bars," applied in a direction at right angles or nearly so to both sides of the beams, "and " rivetted or connected to both, and fitted, where necessary, with " filling up or bedding pieces for affording additional support to " the intended coverings or surfaces." Beams suitable for this purpose are constructed "with flanges or returns," which afford convenient surfaces for connecting or rivetting the beams together, and to the struts, or ties, or bars used in combination with them. The beams may consist of "channel or gutter shaped iron" arranged so as "to present a flat surface, and two returns at right " angles;" or they may consist of pieces rivetted together to the required form; or they may be "step or Z-shaped"; or "they " may be simply flat plates or bars."

Framing thus formed may be used for the "cradlings for " foundations or piers of bridges," and likewise in the construction of dock gates, the bottoms of floating docks, the flooring of warehouses, and other coverings and surfaces; as also in the building of armour-plated vessels, the latter having "a triple or " compound skin applied externally" upon such framing, "the " said skin consisting of two thicknesses of armour plates, with " solid timber filling applied between the two. The inner metal " portion of the skin may be rivetted to the framing, and the " outer metal portion may be bolted to the framing through the " wood and the inner metal portion."

[Printed, 4*d*. No Drawings.]

A.D. 1862, June 27.—N° 1892.

BANKS, Daniel Lancaster.—(*Provisional protection only.*)—" A new method of constructing a portable covered coffer dam or " apparatus for facilitating operations under the water, in the " water, or out of water, and apparatus connected therewith."

This invention is meant to facilitate the examination and repair of the bottoms of ships and other floating structures, whether in or out of the water, and also the examination of the bottoms of rivers or other waters. The apparatus used consists, in the first place, of a box of suitable material, by preference of an oblong shape, and open at one end. This box is divided into two compartments, of which one is thus closed while the other is open; and round the inner edge of the open compartment is a flange, to which is attached, by means of bolts or otherwise, vulcanized india-rubber, or some other flexible material, in such form as to constitute a continuation of that compartment. The description of the invention in somewhat confused, but it would seem that this india-rubber, or other flexible material, is meant to form a flexible tubular passage from the box to the object or place to be examined, such material being kept in a distended state by ropes or rods, or other suitable means, and the end of the passage farthest from the box having around it either a pipe partially filled with water or air, or some thrummed matting or other elastic substance, a connection between this end of the passage and the body or place to be examined being formed by means of "set bolts," which pass through the flange mentioned above, and the points of which act against pressure plates or battens, and so force the pipe or other yielding substance against such body or place, the bolts being worked from the inside of the box. The closed compartment has on each side an elbow pipe turning in a stuffing box, these being both connected to one main pipe, the whole being sufficiently large to admit of the passage of workmen into the closed compartment, from which access is obtained to the open compartment and flexible passage by means of a manhole furnished with a water-tight cover; the main pipe being, if necessary, in several lengths jointed together, so as to be capable of turning into different positions, and being apparently meant to form a means of communication betweeen the box when under water and the surface of such water. Arrangements of any suitable character may be employed for withdrawing water from the apparatus and supplying air thereto, and the whole apparatus may be mounted on wheels, to facilitate its being moved along a vessel's side or otherwise, being provided also with sheaves and ropes for placing it in position. Through the main pipe may be passed other pipes suitable for conveying liquids or other articles into the box, or for conveying hot air to *dry the object* under examination, speaking tubes, and suitable arrangements for lighting the box, being also provided. For certain purposes the main pipe may be dispensed with, and in some cases the box " may be hung in the same manner as a compass, " with a tubular communication through its hangings from the " main to the compartment," and the main may be furnished, if necessary, with a floating ball and ballast, in order to regulate its buoyancy.

[Printed, 4*d*. No Drawings.]

A.D. 1862, July 16.—N° 2037.

SELBY, George Thomas.—" Improvements in apparatus for " superheating in tubes and tubular articles, and in machinery " for the manufacture thereof."

According to this invention superheaters are constructed " of " one or many tubes of a worm or spiral form, through which " the steam or gas to be superheated passes," such tube or tubes being heated from the exterior in a suitable furnace, and the spiral form of such tube or tubes admitting of expansion and contraction in the length thereof " without affecting the joint or con- " nection to the part where the tube is fixed."

When a series of these tubes are used their ends are united to other tubes, which form the communications between them, and which are not spiral, but are thicker at the part to which the spiral tubes are connected than elsewhere, " the ends of the spiral " tubes being screwed in or otherwise." And these " thick-sided " tubes " are mentioned as being applicable for various purposes, including " bridge and roof girders," pillars, and surface condensers. Such tubes may be formed by machinery similar to that used for making and welding ordinary iron tubes, but the dies which are used for bringing the edges together before welding (after the metal has been prepared in a suitable rolling mill) being so formed as to admit the thicker parts to pass through them, a similar provision being made in regard to the rolls and mandrils by which the welding is performed. Or the thick parts of such tubes may be produced by first welding or rivetting at the ends a suitable piece of metal, laid along the tube, and then united therewith by rolls while in a heated state.

[Printed, 8*d*. Drawing.]

A.D. 1862, October 10.—N° 2738.

SUTHERLAND, DOUGLAS SYMONDS.—" Improvements in " constructing beams, girders, bridges, and viaducts."

The object of this invention is the construction of a beam, girder, bridge, or viaduct " that shall be self-contained while re-" taining the distinctive features of a suspension bridge, that is to " say, the power exerted by means of the anchorage or otherwise " in the maintenance of a suspension bridge is applied and " diverted " in another form and direction, viz., " within the struc-" ture itself." The patentee effects this " by means of a combi-" nation of compression or straining beams, and of suspension " bars or tension rods, whose arrangement may be described as " follows :—There may be two or more main beams, girders, or " suspension trusses, tied together and kept apart by cross beams, " which divide the structure in its length into a certain even or " uneven number of bays or panels. The ends of these cross " beams are round pins. Between and butting against these " pins are the horizontal compression or straining beams, and " working on and about the same pins as a centre are the lesser " or vertical compression or straining beams. The ends of these " vertical straining beams are in elevation double-headed, i.e., on " each side of the centre line of the piece is a round hole for the " reception of a pin, or they may be in line exactly in the vertical " axis of the beam; thus there are two pins in each end of each " vertical straining beam; these pins secure a double and parallel " line of suspension bars or tension rods, which unite the opposite " ends of the straining beams diagonally throughout the con-" struction. From the action of the mathematical figures in-" volved in this double-headed arrangement of the vertical strain-" ing beams, and of the double parallel tension rods, one set " become main, and the other counter suspension bars. The " vertical straining beams working on the cross beams which rest " on the abutments, may, in view of the transverse strain upon " them, be reduced in length or increased in dimension, but " where more than one span of like opening is needed, the system " may be continuous over the pier or piers. The vertical strain-" ing beams may or may not be double-headed in cross section. " The horizontal compression beams may be single, in pairs (for " each main truss), or of greater number. Each suspension and

" counter suspension bar may be of a single piece, or it may be " subdivided in length and section; also the adjustments of their " lengths may be made by means of right and left handed screws, " wedges, keys, or other known methods. The superstructure " may either rest upon or be fastened between the cross beams, " and a connection may or may not be made with the horizontal " compression beams; or it may have no connection with the cross " beams, and rest solely upon the horizontal compression beams."

[Printed, 10*d.* Drawing.]

A.D. 1862, October 22.—N° 2847.

HUGHES, EBENEZER WILLIAM.—(*Provisional protection only.*) —" Improvements in turntables and turnbridges."

According to this invention, the fixed circular track upon which the bridge or table is supported and turns is furnished with a groove, which is by preference of elliptical section, and is arranged between two circular ridges or rails suitable for the support of wheels. The lower surface of the bridge or table is provided with a corresponding groove, and in these grooves are a number of spheres, which form the support of the bridge or table. In the centre of the fixed circular track is a fixed upright axis, which passes through the nave or boss of the table or bridge, small spheres being introduced between the axis and the interior of such boss or nave; and turning upon the upright axis is also a circular frame, which is composed of a ring of somewhat less diameter than the inner rail of the fixed circular track, and has radial rods or bars passed through it, these rods or bars being connected at their inner ends to a central boss or nave, and carrying on their outer portions wheels, which rest upon the ridges or rails and support the frame. This frame is between the circular fixed track and the turn-bridge or table, and the bars or rods carry, in addition to the wheels which support the frame, other wheels of such size as to fill or nearly fill the spaces between each two of the spheres in the grooves mentioned above, thus keeping them at a proper distance apart, and the whole constituting an arrangement which, the inventor states, will not only efficiently support a turn bridge or table, but enable such bridge or table to be moved by the application of " comparatively small power."

[Printed, 4*d.* No Drawings.]

A.D. 1862, October 28.—N° 2904.

DUNCAN, Chares Stewart.—" An improved compound or " material for coating or covering metallic and vegetable sub- " stances to preserve them from corrosion or decay."

This "compound" consists of marine glue, gutta percha, india-rubber, shellac, mastic, copal, vegetable or mineral pitch or tar, " or resin, or iodine, or sulphur, or creosote, or asphalte bitumen and coal tar, in combination with one or more of the following substances :—Alumina, schist, quartz, slate, silex or flint, marble or pozzolano, sand, sandstone, cement (natural or artificial), chalk, glass, emery, tripoli, white oxide of zinc or of lead, or the litharge or red oxide of lead, in every case reduced to a fine powder, " in proportions varying from one-fourth part to five " parts of these powdered materials to one part or more of the " before-mentioned plastic substances." The materials, when mixed, are heated, "to reduce them to a plastic or semi-liquid " state," and are then laid upon the article to be coated while the latter is in a heated state also, the compound next being covered before cooling with one or more of the mineral powders, to remove " all stickiness or tack." The surface may then be brought to a polished exterior by rubbing, and may, if necessary, be covered with "a coating or varnish composed of copal, cupreous, or other " varnish, or naptha, parrafine, camphine, petroleum, or other " mineral or vegetable oils, or silicate of potash or of soda and " sulphuric acid mixed with one or more of the above-named " pulverized substances. The coatings may be repeated if it is " desired to obtain extra thickness and protection."

" These mineral earthy substances must in all cases be " thoroughly washed and freed from impurities, and then be kiln " dried to desiccate and destroy vegetation. For a very hard " coating the substance should be composed of seven or eight " parts of silica, or pozzolano, or chalk instead of silica, to four " parts of mineral pitch or tar, and two parts of vegetable or " Stockholm tar."

This invention may be applied in the coating for protective purposes of bridges and similar structures, whether of metal or wood, as also to wirework, palings, railway sleepers, telegraph posts, and other articles, and is also applicable to the preservation of ropes or strands of hemp, or to any fibrous or textile materials or fabrics. Where desirable, the compound may be covered with a coating of ordinary paint.

[Printed, 4*d*. No Drawings.]

1863.

A.D. 1863, April 2.—N° 851.

JONES, WILLIAM.—(*Provisional protection only.*)—" Improve-" ments in the construction of ships or vessels, part of which im-" provements are also applicable for constructing buildings, and " for various other purposes in which rolled iron is employed."

This invention relates, firstly, " to rolling bar or angle iron with " shoulders or recesses, against or in which corresponding parts " of a contiguous bar will fit," or against which the edge of a contiguous plate may butt, such arrangements adding greatly to the strength and rigidity of structures in the formation of which such bar or angle iron may be employed. Iron rolled upon this principle may be advantageously used not only for shipbuilding, but also in the erection of bridges, houses, and other structures.

For the keels of ships the inventor proposes " to roll the bars " in pairs, one part of which will have a projecting rib, while the " other part will have a recessed groove rolled in it to receive the " projecting rib of the other part. When the pairs of bars are " firmly bolted or rivetted together with break joints, a keel of " very great strength will be produced," the bars, moreover, being of such a section that a channel or way for the passage of water along the keel will be obtained.

The second part of the invention relates to the construction of ships or floating batteries. For such as require a keel the latter is formed in the manner already mentioned, and on " the top of " the side flanges of this keel are bolted or rivetted the garboard " streak plates, which are made of thick plate iron of sufficient " strength to receive the angle-iron flooring bars, which may, if " desired, be made with butt and shoulder joints, so as to assist " in resisting the endway strains."

Armour-plated vessels are constructed with inner and outer skins, connected by bars of angle iron, " constructed on the butt

" and shoulder principle already described," the bars being " arranged diagonally alternately in opposite directions, the ends " of the diagonals being made to butt against the shoulders of the " end pieces, which are rivetted to the inner and outer skins," and the spaces between the bars and skins being filled in with hard wood blocks or other suitable material. " The armour plating " may be placed either all externally or partly inside and partly " outside the vessel, as may be preferred, but the lower part or " bottom of the vessel should be sheathed with wood, in order to " be coppered."

" In constructing iron-clad floating batteries, the upper part is " made convex, and a well or vertical hole is made down through " the vessel for the convenience of working an anchor or a pro- " peller. Openings may be made to communicate from the " interior of the vessel to this open well, for the purpose of venti- " lation. A narrow gallery is constructed round the vessel, so " as to enable the occupants to get into or out of boats, or for " other purposes."

[Printed, 4*d*. No Drawings.]

A.D. 1863, April 20.—N° 984.

HUGHES, EBENEZER WILLIAM.—" Improvements in turn- " tables, turnbridges, and slips."

In this invention the fixed circular track upon which the bridge or table is supported and turns is provided with a groove of (by preference) elliptical section, such groove being arranged between two circular ridges or rails, adapted for the reception of wheels, the lower surface of the bridge or table having in it a corresponding groove, and a number of spheres placed in these grooves forming the support of the bridge or table. In the centre of the fixed circular track is a fixed upright axis, which passes through the boss or nave of the table or bridge, small spheres being placed between the axis and the interior of such boss or nave; and turning upon the upright axis is also a circular frame, which consists of a ring of somewhat less diameter than the inner rail of the fixed circular track, and having radial rods or bars passed through it, these rods or bars being connected at their inner ends to a central boss or nave, and having on their outer portions wheels which rest upon the ridges or rails and support the frame. This frame is between the circular fixed track and the turnbridge or table, and the bars or rods carry, in addition to the wheels which support the frame, other wheels which are of such size as to fill, or nearly fill, the spaces between each two of the spheres in the grooves mentioned above, the spheres being thus kept at a proper distance apart, and the whole constituting an arrangement which, the patentee states, will not only efficiently support a turn bridge or table, but enable such bridge or table to be moved by the application of a comparatively small force.

In order to prevent accidents which might arise from a turn bridge or table not being in the proper position when a train passes on to it, apparatus is provided for locking or securing the bridge or table when brought into such position, and signal apparatus is also contrived so as to indicate whether or no the bridge or table is properly arranged. "With these objects sliding bolts are " employed, which are put in motion by means of an axis having " at each end a winch handle; this axis is about the centre of " the turntable or turnbridge, and is arranged to move sliding " bolts in opposite directions, so as to lock the table or bridge at " both sides. At the same time the axis act in the usual manner " on and communicates motion to signal apparatus of the ordinary " construction, and in such manner that the red or danger signal " is shown when the bridge or turntable is not in a condition to " receive a train, which signal will only be changed to the white " or safety signal when the sliding bolts have been moved into " position to lock the table or bridge."

A modification of the invention is described as being applicable in drawing vessels out of the water, along slips or ways in which spheres and wheels working in "sets" are arranged in connection with "blocks" upon which the vessel is sustained, the spheres and wheels being connected to endless chains, and so arranged that one part of them are constantly below and supporting the blocks, while the rest are travelling round inside it, and the patentee mentions that such an arrangement may also be applied to bridges and turntables, in place of that first described.

[Printed, 10*d*. Drawing.]

A.D. 1863, April 29.—N° 1086.

HENRY, Michael.—(*A communication from François Coignet.*) " Improvements in apparatus for manufacturing beton and " artificial stone, pugging clay, and other similar purposes, and "in the production of artificial stone, and artistic, ornamental, "and decorative articles, works, and surfaces."

This invention relates mainly to the manufacture and application of a certain beton or artificial stone for which patents were granted to François Coignet on the 26th of November, 1855, N° 2659, and on the 6th of December, 1859, N° 2757. The patentee mentions that hitherto machines constructed for the manufacture of such articles "have been provided with one or two small "ejection orifices, through which the materials were forced out or "discharged," but that according to this invention the machine is formed with an ejection opening extending continuously or nearly so round the discharge end of the machine, or with a number of large, or numerous, or both large and numerous ejection openings, so that the materials are discharged from the machine freely and continuously, and with little or no obstruction or resistance. "The chamber or casing of the machine is constructed "of three parts, one of which, wherein are the ejection openings, "being below the two others, and one of these latter is remove-"able, so that the chamber may be easily cleansed. In this "chamber a shaft revolves, carrying appliances for mixing, "kneading, or otherwise acting on the materials, and others for "pressing, drawing, or heaping them towards the ejection orifices "and for discharging them therefrom. The passage through "the ejection orifices may be regulated by an annular valve."

The materials to be used are first partially mixed by an endless screw in a trough outside the machine, and are raised thence by an elevator and discharged with the machine itself, where they are acted upon by arms fixed upon a rotating shaft, and blades projecting from the interior of the casing, a fan or wheel with spiral blades drawing the material together towards the bottom of the machine, and revolving cycloidal or segmental arms or blades driving the material through the ejection orifices.

The invention also relates to the production of artificial stone and artistic and ornamental articles, surfaces, and works in Coignet's beton or composition. "For these purposes the best "materials should be used in the beton, such as theil or blue lias "lime and Portland cement or other superior ingredients. The "powdered lime and cement should first be mixed in a dry state, "and combined with sand, broken or powdered marble, glass, "granite, flint, or other hard natural stone or substance, and "mineral color if required. When mixed they are introduced

" into the machine described with a little water, and after having " been treated therein are left at rest a little while and subjected " to a second treatment in the same or another like machine; " this may be repeated or protracted. The whole is then sub- " jected to sustained and forcible agglomeration, and a product " will be obtained capable of being polished by friction. For " this purpose it is first indurated by drying, exposure to air, or " coating with biphosphate or bicarbonate of lime, or silicates or " other saline matter, and is then rubbed with sandstone grit, " emery, trip, rouge, or other such matters, employed consecu- " tively or otherwise. If this should rub off the outer or indurated " surface the block or piece of beton or composition is washed "and again dried and indurated by coating with saline matters. " This may be repeated after each polish."

Imitations of agate, porphyry, jasper, and granite, as well as other ornamental effects and articles, may be produced by employing " coloured and variegated agents " in the manufacture of this beton; and if desired these agents may be at or near the surface of the beton, " leaving the rest thereof unmixed." This last effect may be produced by forming the articles required in moulds, by which means the colouring agents may be kept to the outside of such articles. And the patentee claims the production of statuary and other articles from this beton in moulds composed of " plaster, beton, cement, and similar materials," as one part of his invention.

This beton may be employed in the construction of bridges and viaducts, as well as other erections, in some cases the beton being strengthened by the introduction into it of wire, cloth, nails, hooks, or fragments of wire or metal.

[Printed, 10*d*. Drawing.]

A.D. 1863, May 27.—N° 1332.

KENNARD, Howard John. — " Improvements in the con- " struction of wrought-iron cylinders for piers or piles to bridges, " viaducts, or for other foundations or structures where the sink- " ing of cylinders is required."

This invention consists in constructing cylinders of wrought iron, " where such cylinders require to be made air or water tight " for the purpose of being sunk into the ground, by first forming " any convenient number of segments that the size of the cylin- " ders may require," each of which segments is provided with an internal flange, fixed or formed all round the edges of the same, the surfaces of such flanges and edges being then planed, and the segments connected by bolts passing through these flanges, suitable packing being, if desirable, interposed between such surfaces.

The patentee thus defines the manner in which he prefers to form the flanged segments:—

"I manufacture an angle iron of such a form that upon one " external face of the same there is a raised surface or fillet " running along at or near the apex of the angle iron. I then " rivet this angle iron in an air or water tight manner upon the " inner surface of the plates forming the segments round the " edges of the same, in such a manner that the side of the angle " iron having the raised surface or fillet forms the flanges to the " segments, it being for this purpose provided with the requisite " bolt holes. I then plane or turn such raised surface or fillet of " the flanges so formed, and also the edges of the plate, so that " the fillet and the edge of the plate together form a perfect plane " meeting surface, thereby insuring a water or air tight joint " between the segments when bolted together to form the cylin- " der. Or, instead of employing the before-described form of " angle iron for forming the flanges, I employ tee-iron for that " purpose, rivetting the table of the same to the plate, and " planing the edge of the table, together with the edge of the " plate, to form the air or water tight joint."

"In other cases I rivet the ordinary form of angle iron upon " the plates in such a manner that the edges of the plate project " slightly beyond the angle iron, and I then plane the edges of " the plates, so as alone to constitute the meeting surfaces, and I " insert suitable packing between the joints of the segments when " they are bolted together, so as to render the cylinder air or " water tight. Or I sometimes form the said flanges by setting " up the metal of the plate itself, or by welding or rolling the " metal for forming the flanges on to the plates."

[Printed, 10*d*. Drawing.]

A.D. 1863, July 10.—N° 1723.

DE BERGUE, CHARLES.—" Improvements in piles for founda- " tions, and in piers for bridges and other buildings or struc- " tures."

This invention consists " in constructing iron cylindrical or " *other* shaped piles (cast iron being preferred) of a series of

" lengths, capable of being united to form a long continuous pile " by turning the ends to fit square against each other or at right " angles to the length, and either by enclosing the ends in a belt, " or ring, or socket screwed to receive the ends, and forming " to them screws to fit the socket, or by connecting them by " screwing them together, without an external or projecting " socket, one into the other, or both on to a connecting tube or " piece, screwed externally or otherwise than by flanges (as the " main object is to use hollow lengths of a diameter too " small to admit access internally for bolting together), and " in combining a series of so constructed piles into a foundation, or pier, or substructure; and if continued into a superstructure by capping, bracing ties, or other framing or " means of union. The intention is that the bottom length is to " be pointed, and that the pile, either in two or more lengths, is " to be driven by means of a heavy ram with a small lift, so as to " produce an effect assimilating to pressure rather than a sharp " blow, and using a temporary capping of metal or wood or other " materials, either separately or in combination, the capping " being removed and transferred to the top of each length as it " is successively added. If any inequality of level of top surface " of a series of such piles should occur from difficulty of driving " to an uniform level, then special top lengths may be employed. " When belts, rings, or sockets are used they may be projecting, " or partially or completely countersunk. Where the ground is " soft, and to this case the invention is more particularly applicable, the piles should be hollow for substructure, but for the " superstructure may be either hollow or solid."

Among the advantages claimed by the patentee for this invention he mentions that " the piles or tubes can be cast with more " than the usual soundness and economy, owing to the absence " of lugs and projections on their surface, which enables the " moulding of them to be effected by machinery, and consequently the core to be preserved perfectly central during " casting."

[Printed, 1*s.* 4*d.* Drawings.]

A.D. 1863, August 6.—N° 1937.

DOWSON, Joseph Emerson.—" A new application of rolled " metal plates to the formation of roadways, bridges, tramways, " and other structures."

This invention relates in the first place to the manufacture and use of rolled metal plates of a trough-like section, having flat, concave, convex, or otherwise formed soles or webs, with angular edge plates or flanges along each side, or with a single flange when intended for railway purposes. The double flanged plates are bolted or otherwise attached together, " flange to flange, the " said flanges lapping over or abutting against each other, or " having abutment pieces of metal or other suitable hard material, " placed, fitted, or run in between the surfaces in contact, and " which surfaces may be either flat, or one may be made hollow, " concave, or undulating, while the other is made round, convex, " &c., to fit the neighbouring plate." Or such plates may be joined by angle iron rolled to the required section; or they may be joined flange to flange by inverting every alternate plate; or they may be placed flange to flange in regular order, to form an arch or invert; or they may be joined so as to form a cylindrical structure, in which form they may be used in constructing the masts and yards of ships and the like. Such plates may also be combined so as to form the soffits of arches, or the roadways of bridges, as well as platforms, floors, breakwaters, and other " sea " or river structures," and may be applied in the formation of " all land or marine structures, or parts thereof, whether of an " engineering, architectural, mechanical, or other character."

The invention also relates " to the application of the aforesaid " metal plates to the formation of hollow shafts, columns, piles," and other hollow structures and articles " by joining the plates " with single or double headed T iron, the soles or webs of such " plates being flat, concave, convex, or otherwise formed, and the " angular edges or flanges made to project internally or externally, " or both internally and externally, according as the case may " require." And these structures or articles may be strengthened by introducing " a flitch plate or plates running through their " axes longitudinally and extending across, between, and through " the flanges or longitudinal joints transversely," such flitch plates being of metal or any suitable material, and in con- " tinuous, sectional, or trussing form," as requisite.

Another part of the invention relates to " the formation of " grooves or channels in combination with hollow shafts, columns, " piles, struts, and the like, formed of the said metal plates as " aforesaid, by attaching such grooves or channels to the said " shafts, columns, piles, struts, and the like through the flanges " *thereof, which* grooves or channels will serve to hold in place

" slabs of stone, plates of metal, timber, framed or otherwise, or
" any other suitable material for forming retaining sea and other
" walls, or for holding in place the aforesaid rolled metal plates.
" The said grooves or channels may be made of metal or other
" convenient material, and may either be made of one or more
" pieces."

Another part of the invention consists (as already alluded to) in the application of plates having a single flange for railway purposes, in this case the flange running longitudinally along the outer side of a plate rolled into the form of a portion of a cylinder, the flange supporting a rail which is hollow on the underside so as to fit thereon, and the other portions of the plate curving downwards from each side of the flange and " resting upon the " ballast," the two lines of plates and rails forming a railway, being united by suitable struts and ties, and a cushion of india-rubber or other suitable material being placed between the under side of the head of the rail and the top of the flange. The ends of these plates may be secured together by fishing plates, angle irons, flanges formed upon them for the purpose, or any other suitable means, but one arrangement of parts applicable for a railway is, however, described in which the plates have a flange at each edge, turning either upwards or downwards, and the rails of the permanent way are secured with the aid of blocks or chairs to the middle parts of the plates, the rails apparently being placed across the plates, and not running in line with them.

[Printed, 10*d*. Drawings.]

A.D. 1863, August 13.—N° 1998.

DENNETT, CHARLES COTTON.—" An improved method of " fireproof construction for buildings by the use of arches formed " of concrete."

This invention consists in the employment, in the construction of fireproof buildings and other structures, of a certain concrete, which is used in the form of arches. The concrete is mentioned as being composed of sulphate or carbonate of lime, together with broken calcined cinders, bricks, or other porous material, in such proportions as may be found suitable for the particular structure required, this concrete being " laminated with either " wood or iron." The patentee states that the precise proportions cannot be given, " as they will differ according to the

" greater or less strength required," and he states that for bridges or viaducts, as also for the foundations of heavy buildings in " soft or boggy situations," the concrete is " made with hydraulic " materials."

This concrete is described as being applicable to shelves and benches for pantries and larders; trimmer arches under hearthstones; floors for cottages, " the top surface being polished," and the arch acting " as both ceiling and floor in one mass;" churches and other public buildings; the floors of mills and warehouses, where the concrete may or may not be covered with a wooden, tiled, or stone flooring; and also for dormer or lantern lights. The arches may rise from suitable girders or springing pieces, and may be provided with ventilating pipes or flues, or other adjuncts as required.

[Printed, 1s. 8*d*. Drawings.]

A.D. 1863, August 24.—N° 2096.

STACK, Frederick Rice.—" Improvements in the construction " of military bridges, piers, landing stages, and escalading apparatus."

According to this invention each bridge or apparatus is constructed longitudinally of two or more beams or frames, which beams or frames may be composed of upper and lower bars, either or both of which may be of curved form, trussed with vertical trusses, and braced by diagonal rods or ties, the whole composed of suitable materials and so contrived as to combine strength with lightness. These beams are combined together transversely, and a floor formed between them, this being effected by the use of fillets of wood, plates or bars of metal, or strong basket-work or wire netting. This apparatus " is mounted near one of its ends on " an axle, with or without springs, having two or more wheels, " which may be readily removed from and readily applied to the " axle as occasion may require. At that end of the beam which " is mounted on the axle there may be for some purposes applied " a system of cross bars, by which a number of men may be " employed in moving the beam in the required directions. " Behind or before the axle, or between it and the men or horses " or other motive power employed in pushing or pulling the " apparatus, a strong metal ball-proof shield is attached when " *necessary*, in such manner as to protect the men, and also sometimes to aid in counterbalancing that part of the machine which is beyond the axle. The shield is capable of being placed at any part of the machine, but preferred at a spot behind the axle; other materials may be used as a counter-balance, and the mantlet or shield may be either fixed or moveable. The shield is capable of being retained in an inclined position, so as to cover the men or other motive power who are behind it, and is also arranged to turn on axes, or otherwise, in such manner that when the apparatus has been run into position the shield may be lowered so as to form an inclined platform up which the men may more readily ascend to the platform of the framed beams. In some cases four wheels are employed, and provision is also made for harnessing horses or other animals to the axle or other part of the apparatus. The machine can also be made in such a manner that when not required for use or for transport on board ships it can readily be taken to pieces, and compactly stowed in a small compass; for transport on land it can either be taken to pieces or folded within or upon itself, or slid within itself. The axles, wheels, and shield may be so used as to form a sort of cart or waggon, into which all the short lengths and other portions of the structure can be conveyed," one or more smaller wheels being in some cases added; "or, if more convenient, the whole apparatus can be conveyed from place to place as a common cart, simply on its two wheels. In addition to the above the machine is made in a form applicable for the attack of stockades, New Zealand pahs, or walled defences, even without breaching, by means of jointing the beams or bars supporting the footway so that an inclined roadway will be made up to and down from the wall or like defences, into the enemies' stronghold. This is accomplished by means of upright standards in or near the centre of the beam, which support wire or other flexible ropes, or jointed bars attached to the ends of the beam, which act as suspension or tie ropes or rods during the operation of conveying or pushing the machine forward. When run into position the ropes or bars are loosened, so as to allow the ends of the beams to fall, leaving a platform in the middle, so as to enable any number of troops to ascend at one end and descend at the other."

When the shield is moveable, it is raised and lowered by means of a wire rope passing from it over a pulley carried by an upright standard, and thence to a drum or barrel on which it is coiled, motion being given to this drum or barrel when necessary by a winch and gearing, the same apparatus also serving (by means of another rope) to raise and lower one portion of the beams and platform when it is desired to obtain an inclined roadway on each side of a wall or stockade as mentioned above.

[Printed, 1*s.* 8*d.* Drawings.]

A,D. 1863, November 21.—Nº 2929.

TURNER, Thomas.—(*Provisional protection only.*)—"An improved fireproof floor or roof for buildings, bridges, and other " structures."

Before describing this invention the inventor refers to the ordinary system of forming a fireproof floor by introducing concrete between and over a series of iron beams or joists, the concrete being supported between such beams or joists by laths resting on the bottom flanges thereof, and he then proceeds to state that in this invention the concrete is, according to one modification, made to entirely surround or encompass the iron beams or joists, being applied below as well as between and above them. In other modifications the beams or joists are made " of an open construc-" tion, so that the concrete is continuous and united through the " openings in the beams or joists, and the entire structure be-" comes a rigid and continuous mass." In order to apply the concrete a temporary surface of boards or other material may be placed below the beams or joists, the concrete being poured upon this surface in due quantity, and such surface being removed after the concrete has become " set " and hardened. Plaster to form a " finished ceiling " may be applied to the under side of concrete thus placed, or the under side of such concrete may itself form the ceiling. If desirable, the concrete may be strengthened by " slips " or " straps " of wood or metal embedded within it.

" In some cases, when the beams or joists are of an open con-" struction, and when it is wished to reduce the depth or thick-" ness of the floor as much as possible, the wooden bearers for the " flooring boards may be laid directly upon the iron beams or " joists with or without cheeks, and the concrete may be filled in " only to the tops of the iron beams or joists, or to a slightly " higher level with the wooden bearers partly embedded in it."

[Printed, 4*d.* No Drawings.]

A.D. 1863, November 21.—N° 2935.

FINCH, Edward.—" Improvements in constructing the floors " of bridges, houses, and other buildings."

The inventor says:—" For these purposes, in forming a floor " according to my invention, girders or beams (by preference of " wrought iron and constructed as heretofore) are used, but other " construction of girders, whether of iron or other materials, may " be employed. On these girders or beams bars of **T** iron are " fixed parallel to each other by rivetting or otherwise; or bars " of bridge or trough iron, or of angle iron, or bars of other forms, " may be similarly used in place of bars of **T** iron, so long as " they are suitable for having the edges of sheet iron or steel " fixed thereto. When using **T** iron the sheets or plates are cut " somewhat wider than the space they have to fill, and they are " slightly curved or bent and sprung into the spaces between the " bars of the **T** iron, and are there fixed by keys passed through " holes formed at intervals in the limb or leg of the **T** iron, the " head of the **T** iron bars being fixed to the beams or girders by " rivetting or otherwise. This undulating surface is covered with " concrete, asphalte, or other suitable material, and over that " stone or other flooring is applied. When using bars of other " forms the edges of the bent plates or sheets are fixed to the " angles or sides of such bars by rivetting; in other respects the " construction of a floor is as before described."

Different modifications of the invention are described, the inventor stating that " arrangements of many different forms may " be made " without departing from his invention.

[Printed, 2*s.* 4*d.* Drawings.]

A.D. 1863, December 8.—N° 3085.

THORNTON, Robert.—(*Provisional protection only.*)—" Improvements in the construction of railway and other bridges."

This invention relates to the construction of "bridges of great " span " by " a combination of most or all the principles of bridge " building at present in use."

" In carrying out the first part of this invention one or more " cables of iron wire are used for each girder, passing along the " upper edge of the bridge, and attached to it by suitable appli- " ances. This cable is continued over the top of the piers of the " bridge, and attached to both sides of the river or space to be

" bridged by means of anchors or other suitable fixing apparatus, " and in passing over these piers is secured to another apparatus " to allow for its expansion and contraction. The bridge may " also be constructed of two or more box girders, as circumstances " may require."

" In carrying out the second part of this invention the pendant " lever principle is adopted, and in this case the tubular and lat- " tice girder principles are combined in the manner now to be " described. From the pier ends of the levers and for distances " of two-thirds towards the centre of the span tubular girders are " used; the remaining distance at the centre is completed by a " lattice or bow-string girder; if the latter, it is extended from " about a quarter of the entire distance from each pier, also im- " parting to it the form of an elliptical curve, secured to the main " girder by vertical framework. There are also fixed transversely " web girders, with diagonal stays, thereby imparting to the " whole structure lateral stability."

" The roadway is covered with timber laid diagonally, and " secured to the transverse girders by bolts; and, in the case of a " railway, a second layer of timber is applied longitudinally, to " which the rails are fixed."

Although these improvements are set forth in the first place as relating to bridges of " great span," the inventor states at the end of the Specification that they " are equally applicable to and " suitable for bridges of other kinds."

[Printed, 4*d.* No Drawings.]

1864.

A.D. 1864, February 10.—N° 352.

MIDDLETON, SAMUEL.—(*Provisional protection only.*)—" Im- " proved methods of deadening the noise produced by engines " and carriages in passing along railway bridges and viaducts."

The inventor says :—" The first part of my invention consists " in fitting what I term an absorbent or deadening mattrass to " the under side of bridges and arches. About one foot, more or " less, under the bridge or crown of the arch I place upon proper " supports one or more thicknesses of felt, kamptulicon, or cloth, " *or I employ* a metal or wood floor, and fill up the space between

" it and the under side of the bridge or top of the arch with tan, " sawdust, or other like sound absorbing material."

" My invention also consists in cutting slots, say about a foot, " more or less, long in the rails which are to be used on bridges " and viaducts, and in filling the slots with vulcanized caoutchouc, " gutta percha, lead, or other soft metal. I cause the top of the " filling to spread out at each side, and I also place vulcanized " india-rubber, gutta percha, or other like material upon the " sleepers and under the chairs. I prefer that these filled rails " shall be laid on the bridges and arches, so that the filling in one " rail shall, as it were, break bond with the filling in the other " rail of the pair.".

" My invention also consists in the employment on railway " bridges and viaducts of troughs at the sides of and rising above " the rails filled with water or other liquid, in order that the " wheels may run in water."

[Printed, 4*d*. No Drawings.]

A.D. 1864, February 15.—N° 388.

HASELTINE, George. — (*A communication from George H. Bruce and Samuel S. Shinn.*)—(*Provisional protection refused.*)— " An improved bridge."

This invention " consists chiefly in the novel combination of " two bridge frames to form one bridge, one of which frames is " designated the 'arch frame,' and the other the 'truss frame,' " each being a complete self-supporting structure; and in the " employment of a tongued wedge with each pair of principal " rafters at their apex for the purpose of filling the space left " between the ends of said rafters in such a manner as to compensate for any shrinkage of the timbers or any sagging of the " bridge, as well as to prevent any side slip to the rafters. The " arch frame is composed of several arch beams framed together " at their contiguous ends, and truss braces or principal rafters, " which rafters are placed in pairs and stepped on the said beams " at the foot. There is a pair of rafters for each beam, and " suspension rods which sustain the swing beams forming a part " of the truss frame. The truss frame is composed of the truss " braces or principal rafters, arranged in pairs, and stepped on to " the said swing beams at the foot with suitable tie rods, and " suspension rods which sustain central swing beams. Each of " the tie rods are of sufficient length to pass through three of the

" swing beams in a manner to tie together the two beams upon " which each pair of the rafters of the truss frame is stepped. " These swing beams are so placed when the two frames are " united that one of them will be directly under the apex of each " pair of the principal rafters of either frame," so that suspension rods passing down from the principal rafters of the arch frame will sustain the swing beams on which the rafters of the truss frame are stepped, and those that drop or pass down from the rafters of the truss frame sustain the central swing beams. The wedges have tongues "on either side," which enter into grooves formed to receive them in the ends of the rafters, thus effectually preventing any "side slip" of the latter, and the bridge is also strengthened by metal pieces bolted to the arch beams, and so arranged as to bind the two frames together, these bolts forming " stirrups under the central swing beam."

[Printed, 4*d*. No Drawings.]

A.D. 1864, March 8.—N° 575.

SYMES, James.—"Improvements in pontoons or caissons, " applicable to building structures in water and to other useful " purposes."

This invention is thus set forth:—

" I propose to construct the pontoon or caisson of iron, of any " required dimensions. The proportions which I consider efficient " would be about 100 feet long, 50 feet wide, and 30 feet deep, " the bottom or floor consisting of a horizontal division or partition placed about 20 feet from the top of the caisson so as to " divide it into two chambers, the upper chamber being 20 feet " deep, and the lower chamber 10 feet deep, without a floor or " bottom. A large circular or square hatchway is made in the " partition, and is provided with vertical walls rising to the top " level of the caisson, whereby communication is established " between the upper and lower chambers. The hatchway is " furnished with a valve closing or opening the division as " required. The valve being closed the pontoon caisson is floated " over the spot where a foundation or other work in water is " required to be performed. The valve is then opened and the " water let into the upper chamber, which sinks the pontoon to " the bottom, say to a depth of 20 feet, and when the water in " the upper chamber is on a level with the water outside the

" valve is shut, and water is pumped into the upper chamber " until it is filled up 10 feet above the level of the river or other " water (and the upper chamber must always be left so filled up " 10 feet above the level of the water), so that the 10 feet of " water will cause a downward pressure equal to counteract the " upward tendency of the pontoon caused by the withdrawal of " water from the lower chamber (as hereafter described). This " extra weight of the upper chamber (which can be constructed " larger in area than the lower chamber) will drive or force the " lower edge of the pontoon down into the clay and stanch the " lower chamber, which is then to be pumped out dry, when the " workmen may descend therein through the hatchway."

" The work being finished water is let into the lower chamber " and pumped out of the upper chamber, when the pontoon will " rise. In tidal waters it is evident that pumping may to some " extent be dispensed with, since ingress and egress by apertures " and valves or taps could be arranged for the supply or with- " drawal of water. To operate upon rocky or hard uneven " ground or surfaces I propose to apply a cushion of gutta " percha or india-rubber under the lower edges of the caisson, " whereby the pressure may be communicated to the inequalities " of surface, and a water-tight union effected. Or I propose to " apply to the sides and bottom a chain or rope network and " canvas or other strong flexible waterproof fabric, whereby when " the caisson is lowered and set the work may be begun on such " fabric, and the edges afterwards cut away when the work is " finished and the pontoon is to be raised."

" The caissons may also be made of double sides, open at " bottom, and a gutta percha or india-rubber wall inserted " therein, so that the pressure of the caisson may force the soft " material to penetrate into unequal surfaces, as before. The " caisson may also be made in vertical sections or divisions and " held together by flanges, screw bolts, and nuts, with india- " rubber washers between the flanges for tightness. This ar- " rangement will enable the caisson to be readily removed from " certain descriptions of work."

The invention is applicable in building bridges, as well as numerous other purposes in which pontoons or caissons are equired.

[Printed, 4*d*. No Drawings.]

A.D. 1864, April 4.—N° 836.

STEPHENSON, George Robert. — (*Provisional protection only.*)—" Improvements in the method of levelling for and " forming the foundations either under or above water for " cylinders, piers, sea or river walls, and dams for bridges & " other structures."

For these purposes the inventor uses cutters or jumpers working on a centre previously fixed in the place to be levelled for the foundation, or the centre itself may be used as a cutter. " The " form and position of the cutters or jumpers will be varied for " use in rock or in hard ground, and motion can be given to the " cutters or jumpers by means of steam or other power on a stage, " or on floating pontoons or lighters, as may be convenient."

[Printed, 4*d*. No Drawings.]

A.D. 1864, April 20.—N° 980. (* *)

SHAW, John.—(*Provisional protection only.*)—" Improvements " in iron caissons, and in apparatus to be used in sinking the " same, and in sinking cylinders and piers for making foundations " under water."

The object of this invention "is to facilitate the operations of " sinking caissons, cylinders, and piers, for making foundations " under water, and to economise labor in raising and discharging " the soil or materials excavated, and at the same time dispense " with the use of pumps for drawing off the water."

The invention consists in forming caissons with curved sides and flat ends, " with flanges on the top and bottom of all the " upper caissons, and flanges on the top only of all the bottom " caissons." The ends of the caissons are furnished with projections which " fit into each other and form a puddle box when " put together, and the caissons are built end to end, and raised " in tiers, with water and air tight joints bolted together, to the " length and height required."

" The apparatus consists of a condenser or chamber fixed on " the top of the caisson, cylinder, or pier to be sunk, and is made " to receive air through flexible tubes by means of an air pump " worked by a steam engine to a pressure sufficient to force out " the water from the bottom of the caisson, cylinder, or pier, and " thereby enable workmen to sink the same down to a solid

" foundation without the aid of pumps." The condenser or chamber is made " of sufficient capacity for men to work in, and " is fitted inside with a hopper for discharging the soil or " material excavated, and a small cistern," the hopper being placed on a part of the condenser that overhangs the caisson, and a windlass being fixed over an opening left in the centre of the condenser for raising the soil or material from the caisson. The hopper is furnished with a valve at the top and another at the bottom, the valve at the top being opened when material is to be deposited in the hopper which has been brought up by the windlass, the bottom valve remaining closed, and being only opened for the discharge of the material from the hopper into a punt or barge. The small cistern receives the water drained from the materials in the hopper, such water being allowed to pass away therefrom by the opening of a cock. A pipe is attached to the hopper and descends down the caisson, in order to blow the water out of the caisson when required, the top valve of the hopper being closed and the lower one opened for the discharge of water.

[Printed, 4*d*. No Drawings.]

A.D. 1864, May 25.—N° 1302.

WHITING, JAMES EDWARD.—(*Provisional protection only.*)—" Improvements in girders for bridges and other structures."

These improvements are thus defined :—

" My invention consists in forming the top chord in tension " in horizontal open girders, as hereafter explained. The lower " chord is in tension, as usual. I reverse the strains in the top " chord of those girders known as warren and lattice girders, so " that, instead of being borne in compression at the centre, they " are borne by tension from fixed stays on the land, which stays " are independent of the bridge or girder, that is to say, instead " of the strains in the top chord accumulating towards the centre, " and being borne by a compression plate, they are accumulated " when the bridge is loaded towards the ends and borne by the " stays. The advantage of this will be that the top and bottom " chords can be made in a portable form, such as that of a wire " cable with eyelet holes or in joints, and the latticework or struts " and ties can fold up. Both chords are made in portable form " and flexible, so that the girder can be constructed on shore, and

" may be drawn across any place to be bridged in a loose irregular " catenary, and may then be tightened by a crab or otherwise to " a horizontal position."

[Printed, 4*d*. No Drawings.]

A.D. 1864, June 20.—N° 1467.

CALLEY, SAMUEL.—(*Provisional protection only.*)—" Improve- " ments in the construction of bridges and viaducts."

These improvements are thus set forth :—

" I propose, in the construction of bridges and viaducts, to " introduce certain metallic or wooden rods for the purpose of " strengthening or sustaining the structure, and when desired " suspending the way."

" In order to make my improvements more clearly understood, " I will now describe them only as applied to two piers and one " span or opening of a bridge. I propose to carry a metal rod (or " rods) on each side of a pier to the opposite pier; this rod (or " rods) will start from the foundation (or even below it) of the " one pier, and forming an arch (semicircle or otherwise), pass " into and to the foundation of the opposite or next pier; I " also carry another rod (or rods) in a similar manner from the " foundation of one pier to another of an eliptic span; or I carry " rods of any rise (semicircle, segment, or elipse) in the manner " before mentioned, to support or sustain the sides or framework " of the bridge, or suspend it if required. But if from any cause " I do not require to carry my rods from one foundation to the " other, I rest their ends on any part of the elevation of the piers. " It will be understood that if it be required to suspend the centre " of the framework of the span, the form of the rod must vary " accordingly, and I do not confine myself to any form of rod or " support, as they must vary to suit the circumstances of par- " ticular cases. The arc, semicircle, segment, or elipse, may be of " any material suitable for the nature of the bridge or viaduct to " be constructed. These rods will be attached to parts of the " piers and framework of the bridge wherever required."

[Printed, 4*d*. No Drawings.]

A.D. 1864, August 31.—N° 2142.

FURNESS, GEORGE, and MOORE, LEWIS GEORGE.—" Im- " provements in caissons employed in constructing embankment " and other walls, piers, breakwaters, and other like structures."

The patentees say:—" For these purposes it is preferred to employ caissons of an elliptical horizontal section, but other forms " may be resorted to when carrying out our invention. Each " caisson is constructed, as heretofore, of a series of short lengths " or rings, which are connected horizontally by flanges and screw " bolts and nuts, as heretofore; but in addition to these horizontal joints, each short length or ring is formed of two halves or " parts, which go together by upright flanges fastened by screw " bolts and nuts, so that whilst a caisson consists of a series of " short lengths or rings connected horizontally together, as " heretofore, the two parts or halves of each short length or ring " are connected vertically, so that when a series of caissons have " been sunk to a given depth, and parts of a foundation have " been formed therein to the height where the caissons are to form " permanent parts of the work, the inner halves, or parts of " the caissons which are above the permanent structure, may be " removed, whilst the outer halves or parts are allowed to remain, " in order to present an arched coffer dam to prevent the water " from getting to the interior whilst the work is being carried " up, more or less resting on the foundation or parts of the " foundation formed by and in the lower and permanent parts " of the caissons. In some cases wood or other piles are driven " in the angular spaces where the upright flanges of two neighbouring caissons come together, in order to give support and " render the junction water-tight when the inner halves or parts " of the caissons have been removed. The upright flanges may " not only be used for connecting the two parts or halves of a " short length, but they may also be used for connecting the " neighbouring caissons together vertically."

[Printed, 1*s*. 10*d*. Drawings.]

A.D. 1864, October 20.—N° 2593. (* *)

SHAW, JOHN.—" Improvements in coffer dams, and in apparatus " to be used therein, and in sinking cylinders and tanks for " making foundations under water."

According to this invention the patentee forms the coffer dams " of iron caissons with curved sides and flat ends, the upper " caissons having flanges at top and bottom, and the lower caissons at the top only."

These improved caissons " have also vertical flanges projecting " at right angles from their flat ends, which flanges, when the

" caissons are brought together, fit into each other and form " puddle boxes."

In making a foundation the patentee places these caissons " end " to end, raising them in tiers to the length and height required, " the water and air-tight joints being made by bolting the flanges " together with screw bolts and nuts." They are sunk in the following manner:—On the top of a caisson, making an air-tight joint, is bolted a compartment which is termed the condenser, and by means of an air pump worked by a steam engine air is introduced into the condenser through flexible tubes by an air pipe, " and with sufficient pressure to force out the water from " the bottom of the caisson (as it descends, until it reaches the " bottom), thereby enabling the workmen to sink it down to a " solid foundation without the aid of pumps. Men working in " the condenser raise the excavated soil or material through an " opening left at the bottom of the condenser, using a windlass " or other contrivance suitable for such purpose, and tipping the " soil as it is raised into a hopper placed inside the condenser, " and then, by opening and closing the top and bottom valves," " the soil or material in the hopper is finally discharged into a " barge or other receptacle brought beneath the hopper, or which " may be reached from a trough leading from it."

The valves mentioned above are placed one at the top and the other at the bottom of the hopper, the upper valve being opened for the excavated material to be deposited in the hopper, and the lower one when it is to be discharged therefrom. A cistern connected with the hopper receives any water which may drain out of the excavated material, and a pipe passing from the hopper to near the bottom of the caisson is used for the discharge of water from the caisson by the application of compressed air.

This invention is applicable not only in forming foundations, but also in mining operations and other works.

[Printed, 10*d*. Drawing.]

A.D. 1864, October 26.—N° 2647.

WILTON, Robert William.—(*Provisional protection only.*)— " Improvements in the construction of roofs, walls, partitions, " bridges, fences, floors, and the ribs or framing of ships and " boats."

This invention consists " in bending the ribs used in the above " *constructions* into a serpentine form, so that the sides of the

" adjoining ribs touch each other at certain points, where they are " joined together by bolts, rivets, or otherwise. Also in a variation " of the same principle, which consists in the intertwining of screw- " shaped coils of metal or other material, and used in the same " manner as the serpentine ribs."

Several illustrations of the invention are given by the aid of drawings. In one case serpentine or undulating ribs are placed side by side, and rivetted together at what may be termed the highest points of the undulations, while in another case "screw- " shaped" coils are intertwined in such manner as somewhat resemble a network. The application of the invention to the construction of a bridge or archway is also described, the ribs being here strengthened by transverse bars, and apparently covered in with timber, this arrangement being mentioned as applicable for the "skeleton of a ship" when turned upside down. The inventor does not confine himself to "any precise curves" in bending the bars.

[Printed, 8*d.* Drawings.]

A.D. 1864, December 10.—N° 3069.

SEDLEY, ANGELO JAMES.—" Improvements in the construction " of bridges."

The object of this invention is to construct bridges "without " the use of centering, so as to combine the lightness of the " principle of suspension with the rigidity and strength obtainable " by the arch or girder principle."

The piers are " made portions of the construction of the bridge," the inshore portions of the bridge being built or bonded into such piers. The rest of the bridge consists in the first place of " cantilevers," which are firmly connected to the lower portions of the piers, and project horizontally therefrom, each projecting rather more than one-third of the span of the bridge, these cantilevers sustaining girders which connect them and carry the roadway, the whole being firmly braced together. The cantilevers consist of upper and lower beams, braced together by diagonal and other bars and rods, the form of each cantilever being such that it is much deeper at the part which is built into the pier than at the end which projects over the river, this projecting part being thus much reduced in weight, and these projecting ends are sustained by tension bars which pass upwards and in an inclined direction, then over saddles or supports carried by towers erected on the piers, and then again down behind the latter, where they are fastened to screw piles or other "anchoring" apparatus, such as a cylinder pierced with holes and sunk in the ground, and having bolts then driven through the holes to prevent its being moved. The girders which rest upon the cantilevers and form the rest of the bridge extend from pier to pier, either lattice, box, or other girders being used, and the structure being further strengthened, if desirable, by vertical rods or bars passing from the cantilevers to the tension bars.

The roadway for a bridge of this class "consists, by preference, " of a system of diagonal girders formed of plate and angle iron, " and rivetted together in the form of a diamond; by this means " the weight and strains will be more equally distributed over the " bridge; on the top of this buckled plates or timber may be " placed."

The patentee describes in detail the mode of putting together the parts of a bridge of this kind, the cantilevers being first connected to the piers, and affording the means of fixing the girders " without the use of centering," and states that by these arrangements "the unsteadiness of a suspension bridge is done away " with at a trifling excess in weight over and above that ordinarily " employed" in the construction of such a bridge.

[Printed, 10*d*. Drawing.]

A.D. 1864, December 21.—Nº 3166.

WESTWOOD, Joseph, junior. — "Improvements in iron " bridges."

These improvements are more particularly applicable to the lower members or tension chains of the class of bridge girder for which a patent was granted to James Warren and Willoughby Theobald Monzani, on the 15th of August, 1848, Nº 12,242, but may also be applied to other girders.

After making some observations on the waste of metal in the " overlaps" of the links of the triangles of "Warren's girders," and also on the large amount of drilling required for the pins which connect the links together, and the great length of pins required in such girders, the patentee thus defines his improvements:—

"I take one or more bars of a section or collective section " *proper for* the lower tension link of the end triangle, but of

" length sufficient to span horizontally along two or more triangles. " Along that portion of the length of this bars or these bars, which " correspond to the second triangle from the end of the girder, I " apply another bar or bars of such section that, together with the " first bar or bars described, the second bar or bars shall give the " exact requisite strength for the lower tension member or links " of the second triangle. The second bar or series of bars is of " such length also that it spans the third triangle from the end, " and in some cases it may be even longer. For the third triangle " an additional bar or series of bars overlapping those of the second " triangle is provided, and of such dimensions that with the bar " or bars already reaching along the third triangle the exact " requisite section shall be provided. In this way the lower " horizontal member of the girder is formed of a series of over-" lapping bars or links of such size and so arranged that the " exact requisite section shall be provided in each triangle. The " several bars or links are connected together, and support the " diagonal members of the girder by means of connecting pins in " the usual manner. It may or may not be necessary to complete " the requisite section of the middle triangle (where there is an " odd number of triangles) by links spanning the length of that " triangle only."

" The same general application of overlapping bars may be " made also to the upper horizontal or compression member of " various bridge girders or trusses, and also to iron roofs, the " trusses of which are of analogous construction."

The patentee mentions that, whereas the lower or tension member of a " Warren's girder " are flexible chains, the lower member of a girder constructed according to this invention " would have a " considerable degree of vertical stiffness in itself," and that " it " could be erected, therefore, with less staying or temporary " support."

[Printed, 8*d*. Drawing.]

A.D. 1864, December 30.—N° 3243.

SHUFFLEBOTHAM, Enoch.—(*A communication from John King.*)—" Improvements in girders for railways and for other " purposes."

This invention relates to girders composed of " top and bottom " members and end staunchеons," connected by diagonal struts and ties, one object of the invention being to dispense with the use of rivets.

The invention relates, firstly, to "framing the diagonals." Each of these acting as a strut consists of two bars, while each acting as a tie consists of one bar, the latter passing between the former, and these struts and ties being "bolted together at their "junctions by means of a cast-iron plate on each side, the said "plates being cored out to fit on to the diagonals forming the "said struts."

The invention consists, secondly, in a mode of connecting the diagonals to the top and bottom members. "The top and "bottom ends of the diagonals are provided with a box or shoe; "one end of this shoe is prepared with an abutment to receive "the diagonal bars acting as struts, and the other end is prepared "with a mortice to receive the end of the diagonal bar, acting as "the tie. A space is left between the ends of the diagonals and "the bottom of the box or shoe, which space is filled in with iron "cement, and the said box or shoe bolted to the diagonals with "bolts and nuts."

Thirdly, the invention relates to the "stauncheons," which are made of wrought-iron plates, and "fitted up with one top distance piece," this piece having flanges for connecting it to the upper member of the girder. Midway of the stauncheon is a cast-iron distance piece forming seats for the struts and tie bars, and the lower ends of the stauncheons are bolted to a cast-iron base.

Fourthly, the invention relates to fixing the "cross joists" of the girder, which are "passed through between the diagonals, "having an iron beam underneath sitting transversely on the tie "bars. This bearer is made with a raised part in the middle of "its length, to ensure the weight from the cross joists to pass "through the axis of the girder. When the girders are made in "pairs they are coupled together by cast-iron distance tubes, and "bolts and nuts."

The patentee states that by these arrangements labour and materials are economized in the construction of large bridges, and that the transport of girders to distant parts is greatly facilitated. The "stauncheons" mentioned above are placed at the ends of the girders only.

[Printed, 10*d*. Drawing.]

1865.

A.D. 1865, January 19.—N° 164.

MALLET, ROBERT.—" Improvements in the permanent way of " railways, and in buckled plates to be used therein, the same " being applicable to the construction of fireproof buildings, " bridges, and other like structures; also in the machinery or " apparatus for producing such improved plates."

That part of this invention which relates to the subject of the present series of Abridgements consists in certain modes of constructing buckled plates, in which the curved or arched portions of such plates are of " variable eccentricity," a parabolic or hyperbolic curve (for instance) being used instead of the arc of a circle; " or in place of obtaining the arched principle of the buckled " plate by any continuous curve it may be composed of several " flat faces, meeting at any desired obtuse angles so as to form a " pyramid, truncated pyramid, or series of facets." These improved plates are formed by rolling or otherwise, or they may be cast, and they may be furnished with fillets, or have the edges turned either upwards or downwards, and such edges may be welded or otherwise united at the corners, the patentee describing various modifications of this part of the invention, and mentioning that in lieu of uniting directly together two buckled plates, one plate, either of the ordinary or of the improved construction, may be united by rivets or otherwise to a flat plate, by interposing a trough " or other suitably shaped iron " between the sides of the plates near their edges. And such buckled plates may be of any desired form or contour in plan, and may be corrugated in any desired direction, being composed in some cases " by rivetting " or otherwise combining together any number of separate, flat, " or slightly curved plates."

The invention also includes the employment of " ductile or soft " metal dies in combination with hard metal dies or open frames " in the bending or striking up of buckled or other hollow plates," the patentee apparently meaning that the hard metal die (or frame, when such is used,) shall be moveable, and be actuated by means of steam or compressed air, hydraulic pressure, or other suitable means, while the soft metal die is fixed; the edges of the plates being afterwards sheared by a machine which combines " the principle of the dividing engine with the shears."

Although the patentee mentions these plates as being applicable in the construction of bridges he does not describe any particular adaptation of them thereto, the invention being set forth chiefly as applied to the formation of the permanent way of a railway, "bridge pieces" being combined therein with buckled plates; but these arrangements do not relate to the construction of bridges in general.

[Printed, 1*s*. Drawing.]

A.D. 1865, February 7.—N° 335.

HENDERSON, Constantine.—"Improvements in the con-"struction of roadways, pavements, and iron girders, specially "applicable for the purpose of constructing roads, pavements, "bridges, and all description of buildings."

One main feature of this invention consists in the employment of a peculiar form of girder, which may be used either in the construction of bridges, or for the support of roadways and pavements in general, and also in the formation of fireproof buildings.

These girders are composed of wrought iron, and consist of a broad horizontal lower flange, having a vertical rib rising from its centre, and running from end to end of the flange, this rib being curved or arched upwards to any requisite extent, while the bottom flange is straight. In employing these girders a wall is first built on each side the space to be spanned by such girders, and the latter are then placed with the ends resting upon the walls, and are secured in their positions by "longitudinal skewbacks," which are placed in line with the walls, and which rest upon the end portions of the flanges of the girders, and bear against the ends thereof, such ends being thickened, and, as well as the inner faces of the skewbacks, being sloped "to an angle corresponding "to the radius of the arch." The girders and skewbacks may, if necessary, be further secured together by bolts or other appliances. The girders and skewbacks being thus arranged, an arch of stone or other material may be constructed, by the aid of suitable cradling, so as to reach from the skewbacks on one side of the structure to those on the other, the skewbacks then forming the abutments which receive the "thrust" of the arch, the girders preventing such thrust from displacing the skewbacks, and the walls thus merely acting as vertical supports to the whole. If iron is used for the arch, it is perforated so as to allow the surface water to flow off freely, but if the arch is composed of stone, such water passes through openings formed in the girders, to ducts or drains formed in the skewbacks.

Where the invention is applied to the support of an ordinary road, or the pavement of a street, the walls (which in these cases are "dwarf" walls) are first constructed at a suitable depth below the surface on each side of the street or road, and the girders and skewbacks are then laid upon them, and the roadway or pavement placed upon arches extending between the skewbacks as already mentioned. And where a footway is required at one or both sides of such road or street, " sleeper walls or footings " are constructed outside the dwarf walls, there being supported between the latter and the footings certain framings, which carry tiles or slabs constituting the surfaces of the footways. The surface of the soil below these footways is sloped and covered with tiles or otherwise brought to a smooth surface, and thus conducts any water which may pass down from the surface of the footway to a concealed gutter, laid alongside the skewback, and which also receives the water which may be discharged from the ducts or drains in the latter. Instead of framing carrying tiles or slabs, perforated cast-iron plates may be used for the footways, and the skewbacks may form " curbing " for such footways.

The details of the invention may be variously modified, and in the case of fireproof buildings the spaces between the skewbacks may be filled in with either stone, brick, layers of tiles in cement, or other fireproof material, a level floor being thus obtained without " thrusting pressure on the side walls."

The patentee mentions various advantages as arising from the use of his invention.

[Printed, 1*s*. Drawing.]

A.D. 1865, March 1.—N° 578.

KOCHS, WILLIAM EDWARD.—" Improvements in the con-
" struction of beams or supports applicable to the building of
" bridges, viaducts, roofs, arches, and ships, and in instruments
" to be used therein."

This invention is described under a great variety of modifications. The leading feature of all the arrangements consists " in " suspending or trussing beams at or from several equidistant

" points on the beam, which trusses or supports all trend towards " a certain point of suspension or support, as the case may be." Thus, for example, in the erection of a bridge, a pier or wall being raised on one side of the space to be crossed, a horizontal beam may be projected from such pier, this beam being sustained by tension rods or struts, which are connected to it at certain points in its length, and all converge back towards a certain point in the pier, either above or below the beam, these inclined tension rods or struts being connected together by vertical bars, which are also connected to the beam. This structure will now form one-half of the span of the bridge, and a second similar structure being erected on the other side of the space to be crossed, the projecting ends of the two beams will meet in the middle of such space, and these ends being united a complete bridge will be formed. When the inclined tension rods or struts converge towards a point above the beam they act as suspension rods, the bridge then being in fact a species of suspension bridge, but when the tension rods converge towards a point below the beam they act as trusses. This system is described as being applied to bridges of one or of more than one span, in some cases both suspending and trussing rods being used; in other cases a double or treble series of both being employed, and in other cases the system of rods being so combined as to form an arch, the latter, again, being, if desirable, combined with a system of rods in connection with a straight beam which serves as the roadway of the bridge. The invention is also described as being applied to cranes, the erection of houses, the spires of churches, lighthouses, and the supporting of chimney shafts, as likewise to the construction of the longitudinal and transverse beams and ribs of ships and vessels, and the strengthening of the embankments of rivers. A small instrument is also described as being applicable for the purpose of " demonstrating the construction of truss beams," this consisting of two levers, furnished with indicators and mounted upon the same fulcrum, and so contrived that on a certain weight being brought to bear upon them they will assume positions corresponding with those which should be occupied by the trusses of the beams. A somewhat similar machine, but having " seg- " mental " levers, is described as being used to determine the direction for the struts in beams and supports.

[Printed, 3*s*. 10*d*. Drawings.]

A.D. 1865, March 7.—N° 633.

YOUNG, Edward William.—" Improvements in the con-" struction of bridges."

This invention consists " in forming joints or hinges in bridges " constructed on the bracket or cantilever principle, at two points " in the superstructure, that portion of the bridge between the " two points, and forming the central portion of the span, being " a truss or girder."

The patentee states that, in consequence of this arrangement, when the bracket or cantilever at the end of the span is loaded, and thereby depressed, no strain is communicated to the bracket or cantilever at the other end of the span, it being relieved by the rolling, bending, or turning of the structure at the above-mentioned joints or hinges. Several modifications of the invention are described.

[Printed, 8*d*. Drawing.]

A.D. 1865, March 29.—N° 888.

LEIGH, Frederick Allen.—" Improvements in the construc-" tion of bridges and arches."

This invention consists principally in " forming arches of hollow " cast-iron pipes in lieu of the usual masonry, and dispensing " with beams and girders as they are usually constructed." These pipes "may be round, square, or wedge-like," but the patentee states that he prefers " the elliptic or egg-shaped form, as " better adapted to resist the crushing pressure with less weight " of material than any other." For bridges the pipes are laid transversely to the roadway, and keyed or bolted together, the ballast being laid, and the parapet walls built upon them, the end pipes resting against the abutments. When used as girders for suspension bridges and other erections, the pipes are cast in short lengths, the "chasm" being spanned in the arch form, and the roadway or other structure being suspended or supported above or below, as the case may be.

Different modifications of the invention are described. In one case round cast-iron pipes are used in the formation of an arch, these pipes being laid transversely, and being sustained by " blocks " or slippers of metal," having their ends "radiating to the " radial centre of the arch," the two end blocks abutting against the top of the abutments.

In another case the pipes are employed as girders for bridges, and according to one modification such pipes are "cast with " thickened ends radiating to the radial centre of the arch, and " arc used in the same manner as the stones of an arch of " masonry," while in another modification the pipes are seated in shoes or seatings formed of the same shapes as the ends of the pipes, but distinct from them, and as the metal of the arch expands and contracts the pipes ride in the seatings, and cause the crown of the arch to be raised or lowered, "according to the " temperature."

[Printed, 1*s.* 4*d.* Drawings.]

A.D. 1865, May 11.—N° 1304.

GOODWIN, James.—"Improvements in casting iron girders " and in apparatus therefor."

This invention relates to casting iron girders " with their broad " flanges downwards, in order to obtain increased strength and " solidity," the patentee stating that the strength of the girder depends greatly on the broad flange, " which is placed undermost " when the girder is erected, but which has hitherto been placed " uppermost (or on one side) while casting the girder, and has in " consequence been very liable to imperfections from the tendency " of the upper part of the molten metal in casting to be porous, " or lighter and less uniform than that at the lower part of the " mould."

In carrying out the invention a mould box is used, which consists of three parts or flasks, and the pattern for the girder is in " two or three principal parts," the broad bottom flange forming one part, while the other part or parts compose the vertical feather or rib and the narrow top rib or flange. One flask of the mould receives the pattern of the bottom flange, and the other two receive the pattern or patterns of the vertical rib and top rib or flange, the parts of the pattern being placed in the flasks in succession, and the sand duly rammed into the latter, the sand in the middle flask being supported by combs or feathered plates in the inside of that flask, which are fastened thereto by bolts, which can be removed from the outside and the combs thus left free to move within the flask, the patentee stating that this arrangement prevents the contraction of the casting while setting and cooling from breaking the mould box. The several flasks are secured in their relative positions when the pattern has been withdrawn and the casting is proceeding by means of pins, and certain clamps furnished with screws. The flask containing the broad bottom flange forms the lower part of the mould box when the latter is placed in position to receive the molten metal, and the latter is by preference caused to enter the mould by means of a gate at each end of the box, these gates being furnished with basins or dams which give to the metal a sufficient "head" to cause it to rise to the top of the interior of the mould, these basins also retaining scoræ and impurities, and preventing them from entering such mould.

For very deep girders the mould box may consist of more than three flasks; and for double girders, or girders with two vertical feathers attached to one bottom flange, "one or more combs will " have to be fixed along the middle to support the sand between " the feathers."

The invention is described more particularly as applied to the construction of girders for railway bridges, but is of course applicable to other girders.

[Printed, 10*d*. Drawing.]

A.D. 1865, June 5.—N° 1533.

DE BERGUE, Charles.—" Improvements in the manufacture " of iron piers or erections, applicable more especially for carry- " ing bridges at high elevations, or available for sheer legs and " lighthouses."

This invention embraces, "firstly, improved foundations for the " lower portion of the piers or erections; and, secondly, improved " superstructure for their upper portion."

The main features of the invention will be best understood by the following abstracts from the descriptive part of the Specification :—

" Firstly, my improved foundations consist of a combination " of caissoon arrangements of cylinders, or of iron plates to form " caissoon cylinders or chambers for sinking into the ground, " the combined structure being narrowed or tapered in dimen- " sions from the base upwards, and such narrowing or tapering " being effected by the several lengths of separate caissoons, " which are secured one upon another, being themselves tapered; " or if cylindrical or uniform each in itself, then the several cais- " soons being successively of smaller diameter or dimensions, so

" as to produce the general tapering by a series of sets-off or " steps. It is apprehended that this improvement will be found " of great value, not only as diminishing the amount of concrete " or other filling," "but as permitting the caissoon to be more " easily sunk or lowered," " and also as affording the means of " rectifying to some extent an error in the proper perpendicular " sinking of the caisson."

"Secondly, my improved superstructure to be erected on the " improved or other foundations consists in combining into a " structure by ties or struts, or by both ties and struts, two or " more compound columns or pillars of the following specific " character or features, the said columns not standing vertically, " but being wider apart at the base than above, and nearing each " other, reckoning from the base upwards, and in some instances " uniting at the top, for which purpose parts of the columns are " removed, or are not required to be constructed, so that they " may tie and fit properly against each other. The said character " or features of the columns consists in their being constructed " with three or more principal ribs or vertebræ connected together " with ties and struts on the lattice principle on each face or side, " so as to form lattice columns with three or more sides."

The details of the invention are minutely described, the invention being stated to offer, among other advantages, " a convenient " mode of erecting portable builders' hoists, the parts, or some " of them, for the convenience of transport, being made to bolt " together, instead of being rivetted as for permanent structures." The economy of material arising from the second part of the invention is also fully set forth.

[Printed, 1*s*. 6*d*. Drawings.]

A.D. 1865, July 4.—N° 1765.

LABOURET, Sylvain Benjamin.—(*Provisional protection only.*)—" Improvements in the construction of suspended bridges, " roads, aqueducts, or other ways."

According to this invention a bridge or road is constructed of a tramway suspended from framework, or sustained by masonry or brickwork, in such manner that it is retained at a certain elevation, and receives the wheels of carriages or other vehicles adapted to travel thereon, the wheels of such vehicles being above instead of being below them, and the body of the carriage or vehicle thus being below the tramway. The tramway may be furnished with guides by laying hold of which persons in the vehicles can propel the latter, or such vehicles may be drawn by " cranks to the wheels," or drawn along by chains or ropes.

A structure of this kind may be converted into an aqueduct by being furnished with suitable receptacles for water, and may carry pipes which will serve for the transmission of water, liquid manure, or other liquors, or gas.

[Printed, 6*d*. Drawing.]

A.D. 1865, July 26.—N° 1934.

KENNEY, MICHAEL.—" Improvements in the construction of " sliding or rolling bridges."

According to this invention a sliding or rolling bridge is composed of two or more main beams or girders of metal or wood, " the span of the opening to be crossed, and the length necessary " for a counterbalance supported and travelling on bearing rollers " and withdrawn or moved forward by a rack and pinion, chains, " or other mechanical arrangements." The flooring or roadway is " constructed in two separate parts, one half or portion attached " to the mainbeams, and the other half or portion constructed and " attached to the said beams or girders, but separately framed, " and capable of being raised between the said girders the depth " of the flooring or thereabouts by screws, levers, chains, hydraulic " or other mechanical appliances found most desirable, thus " allowing the bridge to be withdrawn horizontally the width of " the opening spanned longitudinally without interfering with the " approaches or the disruption of the mechanical construction of " the bridge, and when moved forward and shut, the raised portion lowered and in situ presenting a level, perfectly firm " roadway, suitable for either locomotive, or tramway, or horse " traffic."

The details of this invention must be varied according to " the " span, load to be sustained, and material to be employed." In case of a double bridge being required it may be made in two parts, " so that in case of repair one line of rails or side can be " used while the other is open."

[Printed, 10*d*. Drawing.]

A.D. 1865, August 30.—N° 2226.

BROOKES, William.—(*A communication from William Cowell Teasdale.*)—" An improved system of constructing cast and other " iron bridges, viaducts, and other similar structures."

This invention relates "to the application of the principle of " statics, according to which the stress produced by inherent as " well as extraneous weight acts in the direction of the neutral " axis of the iron tubes or cylinders composing this arched system " of construction, combined with a contrivance for controlling " expansion and contraction."

The invention consists "in applying the round or polygonal " hollow cylinder or tube of the above description of material so " as to bring solely its neutral axis into combination, that is to " say, the leading element of this construction is the iron or cast- " iron cylinder or tube, in which merely resistance to compression " through its length is brought into action without relying on its " lateral or cohesive strength."

The patentee states that "it is evident that in this construction " the stress produced by inherent weight as well as extraneous " load will work in the direction of the neutral axis of the tubes, " and that this stress therefore will act upon the greatest possible " resistance of the metal under consideration."

In order to allow for the expansion and contraction of the metal used the bridge is constructed in two perfectly separate parts, "almost in the manner of a pair of hinges," but without the connecting bolt, the semi-trusses composing each half of the bridge terminating at their highest point alternately in concave and convex ends, so as to fit exactly into each other. The extremities of the bridge are "completely rounded off," and "fit " exactly" into concave cast-iron butts fastened to the abutments of the bridge. " In this manner the whole construction shall in " its centre spontaneously rise when its two perfectly rigid halves " are expanding, and retrocede to the proper point when they are " contracting, without injuring any part of the edifice."

[Printed, 1*s*. 4*d*. Drawings.]

A.D. 1865, December 15.—N° 3246.

DE BERGUE, Charles.—(*Provisional protection only.*)—" Im- " *provements* in bridges and viaducts."

According to this invention piers or supports are used in combination with girders, "having cantilever continuations or exten-
" sions in one direction or in both directions beyond the length or
" span between two piers, such cantilever extensions being con-
" structed with progressively decreasing depth or quantity of
" material towards their extremities." The piers or supports are so grouped or disposed that those of two adjoining "independent
" cantilever structures" are placed "so as to bring into juxta-
" position a cantilever extension of the girder of each such
" structure as that the two extensions may together serve to
" bridge over or cover a length or span equivalent, or nearly so, to
" the joint amount of their separate lengths," the connection between the ends of the cantilevers being so contrived as not to hinder their expansion or contraction, nor to destroy their independent character, nor to cause the two to become one or a continuous structure in respect of horizontal strains. A viaduct or bridge thus constructed is intended to have "narrow spans" intervening between "wide spans," the narrow spans being situated between the piers or supports of the "independent cantilever
" structure," the arrangement being such that "the length of
" girder between the piers or supports on which it rests, together
" with its cantilever extension in one direction, shall preponderate
" or more than balance the cantilever extension in the opposite
" direction, and it is deemed desirable that it should also balance
" or nearly balance such last-mentioned cantilever extension when
" the same is loaded."

The ends of the cantilever extensions are connected by means of plates, placed vertically or nearly so, the upper end of each plate being rivetted or fixed to one cantilever and the lower end to the adjoining one.

[Printed, 4*d*. No Drawings.]

1866.

A.D. 1866, January 6.—N° 47.

CLARK, WILLIAM.—(*A communication from Rembrandt Lockwood.*)—" Improvements in bridges."

This invention consists in a mode of constructing bridges by the employment of a series of cast or wrought iron boxes. The arch of the bridge is composed of a number of such boxes, which may be either wholly or partially open, and which are of such external form that each constitutes a segment of a circle. The arch may either be composed of a single range of these boxes, placed end to end, or of several ranges or series placed side by side and so that the boxes "break joint" with each other, the boxes being secured together by bands or cross ties and tightening wedges, or other suitable means. These boxes are then filled with masonry or concrete, by which means the structure is solidified and strengthened. The buttresses of the bridge may be composed of ordinary masonry, and the superstructure formed "to suit the " taste of the builder, or as the intended practical use of the " bridge may require."

[Printed, 1*s*. 2*d*. Drawings.]

A.D. 1866, February 15.—N° 489.

BOUTET, THOMAS CHARLES.—(*Provisional protection only.*)— " A new method of constructing bridges of a single reach or " span from one bank to the other, that is, without piles between " the abutments."

According to this invention a bridge is constructed " by means " of a metallic weft or woof stretched from one abutment to the " other by means of drums or cylinders fixed on the said abut- " ments, and put in motion by a steam engine or any other " motive power. The said woof will be composed of metallic " wire cables stretched parallel to each other, following as near as " possible the horizontal line. Each extremity of the said cables " will be fixed on the said drums, which by their rotary move- " ment would wind them round their periphery to stretch them to " their extreme tension. These cables thus stretched would be " interlaced by other cables crossing over and under each other, " and vice versâ, so as to form a weft, the strength of which " would be in proportion to the size and number of the cables. " This weft would serve to support the scaffolding on which the " bridge would be constructed. These bridges may be built with " one or several woofs of metallic cables with or without iron " crossings, or with rigid metal, such as cast, wrought, or plate " iron. It is therefore neither the form, the metal, nor the mode " of construction which is the principal object" of the invention; *but,*—

"It is, firstly, the means of constructing bridges without piles, "as aforesaid, by means of a wire woof destined to support the "scaffolding;"

"And, secondly, the construction of the body of the said "bridges in metallic woofs, with or without the addition of rigid "iron in the shape of transoms or otherwise."

The inventor mentions that a bridge might thus be constructed across the Dover Straits, or the St. George's Channel, but states that in a bridge passing across "wide distances" he would support the cables by hollow floating cylinders, placed at suitable intervals apart.

[Printed, 4*d*. No Drawings.]

A.D. 1866, March 20.—N° 816.

KING, HENRY.—"Improvements in the construction of coffer "dams."

According to the first part of this invention a coffer dam is formed by driving a single row of piles in a zig-zag form, or, as the patentee terms it, "diagonally," such piles being furnished with walings on both sides, and being covered on the outside (according to the second part of the invention) with sheets of zinc, lead, or other suitable metal, such sheets being at the lower parts "curled," or turned outwards, and embedded in well punned clay, the ground outside the piles being (according to the third part of the invention) excavated by dredging, and such clay inserted into the excavation so made. According to a fourth part of the invention connecting timbers are passed from point to point of the external angles of the diagonal piles, such timbers in combination with certain horizontal and other timbers, secured by bolts and attached to "dolphins," "forming a truss to each bay "of the coffer dam." The details of the invention may be variously modified, and the invention may, if desirable, be used in combination with "half timber, straight, or sheet piling."

The patentee states that he considers that coffer dams thus formed will be of great strength, and at the same time more economical than those formed by driving down two rows of piles and filling the space between them with clay.

[Printed, 1*s*. 6*d*. Drawings.]

A.D. 1866, March 29.—N° 913.

KOCHS, EDWARD, REUTER, THEODOR, and HENRICI, OLAUS.—" Improvements in the construction of bridges, arches, " and roofs."

This invention consists in building bridges, arches, and roofs " as skeleton structures," and the " characteristic and novelty of " the said skeleton structures are specified in the following two " points." Firstly, skeleton structures, according to these im- " provements, " are composed of independent bars or members " of such material and of such section as are suitable to resist " the force acting on them; they meet only at their extremities, " where they, whether in tension or compression, are connected " by a single bolt. Continuous members are therefore never " used in these skeleton structures; they are all at the connecting " points jointed by one bolt. Secondly, the single members are " so arranged that the whole structure becomes one rigid body, " in which the position of each connecting point of the various " members is unchangeably fixed. Thus a triangle composed of " three single bars connected at their extremities by three bolts is " completely rigid, whilst a quadrangle composed of bars similarly " connected at their extremities is not rigid, but will be so by " introducing one diagonal bar." A girder formed entirely of independent members arranged according to these improvements is likewise completely rigid. These structures may be composed of wrought or cast iron, steel, or wood. " The parts " in tension if made of steel or iron may be composed of flat or " round bars, hoop iron, wires, or chains. The parts in com- " pression if not cast may be composed of rolled or flat bars stif- " fened by angle or T iron, or the flat bars may be braced together " in usual ways. The purpose contemplated in this system is to " arrange the material throughout the structure so that the most " favourable condition for bearing a maximum strain with the " least weight of material may be arrived at. This is the object " sought in these structures," the patentees stating that they find " that by the mode of connection no bar is exposed to a bending " force, but only to tension or compression in the direction of its " longitudinal axis, which is the most favourable condition " possible."

" In order to prevent bending of the parts in the main girder, " all cross girders rest on or are suspended from the bolts of the

" connecting points," the main girders resting " at the main " supports on the connecting bolts."

Various modifications of the invention are described, in all cases straight bars being used, which are jointed together in different forms of combination, in some cases so as to create a suspension bridge, and in others so as to constitute a rigid arch. The particular details of these arrangements will only, however, be understood with the aid of the drawings annexed to the Specification. These details include a mode of connecting the ends of the adjoining bars of the " bottom member " of a suspension bridge, which is effected by the use of a bolt passing through holes in the ends of those bars, and also through holes in the ends of corresponding parallel bars a short distance from them, a " strap " passing over the bolt sustaining the end of a cross girder below. In another arrangement the girder is sustained by a bracket projecting upwards from the bolt. In other cases a number of bars are connected by one long thick bolt passing through holes in their ends, washers at the ends of this bolt keeping the bars together, and these washers being secured by screws. Diagonal braces pass between the outer bars, and further strengthen the structure. " Distance pieces," or washers, may be interposed between the bars, to keep them, or any of them, at a proper distance asunder, and the ends of a bridge may be mounted upon or suspended from " pendulums," or supports so contrived that such ends may move slightly either inwards or outwards, as the strain on the bridge may require.

[Printed, 2*s.* 4*d.* Drawings.]

A.D. 1866, April 7.—N° 995.

SCOTT, THOMAS. — (*Provisional protection only.*)—" Improve-" ments in sinking tubes, cylinders, or caissons for the founda-" tions of piers, lighthouses, quay walls, and similar structures, " and for the sinking of mine shafts and wells."

This invention relates to sinking tubes, cylinders, or caissons " in mud, quicksand, and other soft substances," and " has for " its object the ensuring the perpendicular descent of such tubes, " cylinders, or caissons through soil of varying density, and the " avoidance of the necessity of using heavy weight for forcing " them down."

In carrying out the invention it is proposed " to unite or group " together a series of iron tubes, cylinders, or caissons;" or one large cylinder or other shaped chamber divided into two or more compartments may be used, such tubes, cylinders, or chamber being provided with removeable air-tight covers at top and bottom. The cylinders (or chambers) are forced into the soil by atmospheric pressure, "and are controlled in their descent by " allowing more or less air to enter therein, as required. For " this purpose the covers are fitted with the necessary cocks and " connections for enabling air to be forced in or extracted from " any one or more of the cylinders, the cocks being what are " generally known as three-way cocks," for which single-way cocks or valves may be substituted, "whereby air may be introduced into any one or more of the cylinders when a vacuum is " not required, whilst at the same time the exhausting pumps " may continue their action upon those requiring the vacuum to " be maintained. By reversing the pipe connections of the " pumps they are rendered capable of acting either as exhaust or " forcing pumps," and the perpendicular sinking of the cylinders or chambers is maintained by those which meet with the greatest resistance "having the vacuum therein increased, whilst those " which may be passing through a more yielding soil are checked " by introducing air therein."

" If preferred, hydrostatic power may be employed for raising " the cylinders, or if they be raised pneumatically or hydrostatically pistons may be introduced inside for more effectually " securing the air or water, by which the pressure is brought to " bear equally upon the lower strata inside the chambers and at " the top of the same. The cylinders may be built on shore," when required for marine purposes, and are in that case "provided with a watertight but removeable compartment in order " that they may be floated by forcing air between the same and " the floating medium, thus raising it in the water to the required " height; when launched to the required place the compartments " above referred to are then removed, and the cylinders sink to " the bottom," and may then be forced down into the sand or soil, either by simply exhausting the air therefrom, or by both adopting that course and bringing the weight of a body of water to bear thereon in a kind of tank with which the upper end of each cylinder or group of cylinders may be furnished, the sides of the cylinders being carried up above the covers so as to form such tank or tanks; "or the cylinders may be still further weighted " by building inside them a circular wall or lining of concrete,

" the gravity of which acts in conjunction with the atmospheric " pressure."

[Printed, 4*d*. No Drawings.]

A.D. 1866, April 10.—N° 1022.

ROBOTHAM, William Douglas. — (*Provisional protection only.*) — " Improvements in constructing the foundations and " abutments of bridges, piers, jetties, retaining walls, and other " similar works."

This invention relates more particularly to abutments for girder bridges, and consists in the first place in bolting upon a number of screw piles a series of cast-iron plates, " partaking of the " nature of so many girders, which have a bearing on the piles at " one end and are tied at the other to anchor piles with wrought-" iron ties," all the edges of these plates being planed in order " to get a firm and good butt joint." The rest of the invention is thus set forth :—

" For the abutment pillars I carry up a rectangular box with " internal ties, on the top of which a cap is well fitted, which is " the bed plate of the roller bearing of the girders. These boxes " are not necessary beyond that required to take the girder. I " carry up the wing walls in plates similar to the abutment; all " these plates are tied and cross tied, some to each other, so that " the thrust of one counteracts the pull of the other, and the " others are anchored to piles screwed in at that particular line of " thrust. The fixed bearing abutment will not have to be so well " tied as the expansion end, on account of the central girder " taking part of the thrust, the plates being bolted to that girder. " For piers on similarly bad foundations, when there are a number " of arches sprung, I screw four or other convenient number of " piles, and erect thereon a standard which carries rectangular " boxes (as before described in reference to the abutment pillars), " with a cap cast at the required angle to take the brick or stone " arch or girder, as the case may be the end pier will in this " case in a great manner be in equilibrium, the thrust of the arch " counteracting the thrust of the 'muck.'" " Sometimes carry " up the pillars as before explained, and attach thereto plates of " circular or curved shape; the arch of the plate being for the " purpose of meeting the 'muck' thrown against it, the 'batter' " being two to one and upwards. This arrangement is perhaps

" stronger and cheaper than that first proposed, but the appear-" ance is not so good."

[Printed, 4*d*. No Drawings.]

A.D. 1866, May 31.—N° 1526.

NEWTON, WILLIAM EDWARD.—(*A communication from Charles Thompson Harvey.*)—" Improvements in railways, and in propelling carriages and vessels by means of ropes or chains."

One part of this invention consists in a mode of constructing bridges "for elevated or street railways." At each side of the carriage way of the street an upright hollow iron pillar is erected, and on these rest iron girders, which form the bridge, these girders being in two separate sections, which meet over the middle of the carriage way, and are supported by axes mounted in suitable bearings at the upper ends of the pillars. The girders are much deeper at the ends next the sides of the street than at the other ends, and bear upon the axes at points not far from the deeper ends, the upper edges of the girders, however, being in the same horizontal plane when the narrower ends are brought together, and the bearing points being at the lower edges; the arrangement being such that the centre of gravity of each section of the bridge is " through its joint," or bearing. The smaller ends of the girders of one section of the bridge are rounded, and enter recesses in the smaller ends of the others, this preventing the bridge from sinking in the middle when in use. The parts of the bridge are moved so as to allow of the passage of any large body along the street by means of curved racks with bevilled teeth, which are connected to the deeper ends of the girders, and are acted upon by bevil wheels mounted upon upright shafts, the latter being put in motion by gearing which connects them with a horizontal shaft placed in a " subterranean chamber" below the street, and either driven by a small steam engine (which may also actuate cables for driving carriages, &c.), or turned by winches, and suitable apparatus connected therewith, arranged in the street itself; the result being that the two sections of the bridge are turned into a vertical or almost vertical position, and restored into the horizontal position at pleasure. The curved racks are " double," and are each acted upon by two wheels, for the purpose of securing steadiness in the movements of the bridge.

The other parts of the invention do not require notice here.

[Printed, 1*s*. 10*d*. Drawings.]

A.D. 1866, June 4.—N° 1544.

HENDERSON, Constantine.—" Improvements in girders " manufactured in iron, steel, or otherwise, combined with " timber."

This invention relates to the construction of girders applicable to the formation of " roadways, bridges, and railway works, " tunnels, viaducts, piers, fireproof floors, subways, roofs, arch- " ways, lintels, over all description of openings in ordinary " buildings, supporting walls over shop fronts, and in every other " kind of construction where weight has to be carried," such girders being " also adaptable to the construction of ships and " the various parts thereof."

The essential features of the invention will be sufficiently understood from the following description given by the patentee:—

" The peculiar and improved modes of constructing girders on " the principle referred to in my patent, No. 335 (and dated the " 7th day of February, 1865), and as herein described, consist of " a webb or webbs (with or without flanges) and abutments or " skewbacks used in conjunction with an arch or arches of brick, " stone, tile, timber, or other material, the arch or arches being " formed between the abutments or skewbacks forming part of " the girder. The webbs of the girder are generally constructed " of metal, cast or otherwise manufactured, but in some cases " the webbs may be in part formed of iron bands or rods and " timber or other suitable materials combined. The abutments " or skewbacks herein mentioned are either cast or otherwise " manufactured in metal; in some instances, however, the abut- " ments may be formed of timber, or of timber and metal " together, and may be solid or hollow. The inner side of the " abutments or skewbacks are formed to the particular angle to " suit the radius of the intended arch or arches that are con- " structed within the span or space between the two abutments, " and in the centre or sometimes in other parts of the said skew- " backs or abutments I form a tenon or slot to receive the ends " of the webbs as hereinbefore mentioned. In some instances I " form the abutment in cast or otherwise manufactured metal in " the shape of a shoe or plate, the lower side being horizontal to " the wall or foundation, and the inner side is made to incline to " an angle suitable to the arch or arches which abut on to the

" face of this shoe. The webb of the girder may be of rolled or " cast metal, and may sometimes be made in timber in conjunc- " tion with hoop-iron bands, or otherwise strengthened by braces " running parallel therewith, but in common the webb will be of " metal, the form thereof usually being that of a longitudinal " flitch or plank, and the ends thereof are either dovetailed or " twined up to fit the tenons or slots, or in the before-mentioned " abutments or skewbacks, or they are formed to suit such " other mode of fixing as the occasion may require; I then place " the skewbacks or other abutments in position, and securely fix " the webb to the skewbacks by dropping or placing the dove- " tailed or turned-up ends of the webb into the tenons or slots of " the skewbacks, or secure them together by such other means as " may appear best suited to the particular occasion; the arch (or " arches) is then constructed within the span or space (or " between) the abutments and built up clear of the top of the " webb, which is never subject to vertical pressure, but the weight " or pressure is firmly supported or carried by the arches on either " side. In order to obtain the necessary length of the webb " where the spans are of considerable length, as will frequently " be the case in bridge building, the webb will be formed by one " or more plates or pieces of iron, steel, or other materials placed " together, bolted, and screwed together in the usual way, or con- " nected in some other manner. These girders are also particu- " larly applicable to the formation and construction of fireproof " floors, and the only additional arrangement necessary in con- " structing the floors is simply the elongation or widening out of " the skewbacks or abutments before mentioned."

" According to another method, in lieu of the ordinary girder " used for building and other purposes, I prepare an arch with " perforated bricks, stone, iron, timber, or other suitable materials, " and in each brick or portion of other material which forms the " arch I make the perforation to allow of a straight line of iron " chain, rod, or twisted metal wire to pass through the entire arch " when formed, and this chain, rod, or twisted metal wire I " securely fix to the iron skewbacks or abutments as hereinbefore " mentioned, and by this method or construction, as in all other " cases, I never allow the iron chain, rod, or twisted metal wire " to take the burden of vertical pressure, but its entire duty is " that of tension."

After thus setting forth the leading features of the invention the patentee goes on to explain several modes of carrying out the same, and afterwards mentions that he claims the peculiar form of his tension girder "as unlike any girders now made and in " use, the construction being on an entirely different principle to " that of box rivetted, or any other kind of girder now manufac- " tured," the webbs of these girders being "simply made to " retain the thrust of the arch or arches," constructed within the space or span between the abutments "for the purpose of carry- " ing the weight or burden above the opening." He also claims the application of these girders to "bridge building," stating that by such application "the saving and economy of time is " very considerable."

[Printed, 1*s*. 2*d*. Drawings.]

A.D. 1866, July 21.—N° 1891.

SMITH, Hugh.—" Improvements in rivetting, boring, and other " apparatus and arrangements to be used in constructing ships, " bridges, boilers, and other metallic structures."

The patentee states, in the first place, that this invention "has " principally for its objects to methodise, to expedite, to cheapen, " and generally to improve the constructive operations in making " ships, bridges, boilers, and other metallic structures," and that an important feature of the invention "consists in providing " frames or supports for the rivetting apparatus, and in arrang- " ing for the progressive movement of the apparatus as the work " proceeds."

A modification of the invention is described as being applicable to rivetting plates upon the sides of a ship, in which there are, in the first place, erected two frames, one outside and one inside the vessel, these frames consisting mainly of bars arranged in accordance with the contour of the vessel, and supported by links connected to "shoes" temporarily fixed to the vessel. On the outer frame is mounted a moveable apparatus composed of two horizontal bars or tubes connected to certain "carriages," and capable of being raised and lowered on the frame by means of chains coiled on or passed round barrels or pulleys mounted in the carriages and turned in either direction at pleasure by gearing and a winch. On these horizontal bars or tubes is mounted a holder or slide, which may be traversed thereon through the medium of chains and bands, racks and wheels, or screws, this holder carrying a steam hammer, and these arrangements affording the means of bringing such hammer to bear at any required point on the ship's side. The hammer cylinder has formed upon it a "projecting zone," by which it is sustained, this zone resting in a suitable seat provided for it in the slide, and the cylinder may thus be placed at any angle with the ship's side that may be requisite. The piston, piston rod, and hammer head are rigidly united, and the valve of the apparatus is actuated by means of adjustable tappet pieces, springs being so applied as to mitigate the concussions of the valve details. "In other respects the hammer details "are like those of ordinary double-acting steam hammers," this part of the apparatus being furnished with a platform for the use of workmen.

On the framing inside the vessel is mounted another moveable apparatus somewhat similar to that described above, and carrying a "dolly" or "holder-up" for the purpose of sustaining the heads of the rivets while being acted on by the hammer. The dolly consists mainly of a massive bar, so arranged as to oppose the blows of the hammer, and "having spiral blade or rubber "springs and adjusting screws or levers applied to it in any con-"venient way to obtain the requisite pressure," and being by preference arranged with its weight nearly equal on opposite sides of its supporting tube.

Different modifications of the invention may be employed. For example, the hammering apparatus may be placed inside the vessel, and the dolly outside, and instead of a spring dolly, "a "simple weight suspended by suitable tackling," may be used, or the dolly may be shifted by means similar to those applied to the rivetting apparatus; and in adapting the invention to boring, countersinking, finishing, and other similar operations, revolving drills or other tools may be used instead of the hammer, and actuated by steam or other power, and in any convenient manner.

In forming bridge beams, or girders, or boilers, the frames for carrying the rivetting or other apparatus may be fixed to the structure itself or not, as may be convenient. Thus the structure may be supported above the ground, whilst the frames for the rivetting apparatus may be mounted on a carriage or slide, and various arrangements of chains and barrels, "differential pulleys, "or rack and pinion gear, may be used for the same purpose."

[Printed, 1s. 6d. Drawings.]

A.D. 1866, August 6.—N° 2022.

LAMB, Ephraim.—(*Provisional protection only.*)—" Improve-" ments in the construction of bridges and other like or analo-" gous structures."

This invention consists in the employment of "certain combi-" nations of compound levers, such as those employed in the " instrument called 'lazytongs,' in the formation of bridges and " such like structures," and is especially applicable in the construction of military or of street bridges, or wherever the rapid and economical construction of a bridge is desirable. For crossing a river a series of these levers may first be extended from one of the banks, and "supported by means of pontoons or other " analogous contrivances at any desired points," from which other series of levers may be extended in succession. In the case of a street bridge one end of such a series of levers may be secured to suitable bearings or foundations at one side of such street, and the levers then extended, and the street having been "so spanned, " the requisite flooring or footways and protective railings or " fencings can then be attached without difficulty."

[Printed, 4*d*. No Drawings.]

INDEX OF SUBJECT MATTER.

[The numbers refer to the pages in which the Abridgments commence. The names printed in *Italic* are those of the persons by whom the inventions have been communicated to the Patentees.]

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- Formed of curved bars of iron connected by blocks, tubes, pins, &c., iron preserved by being coated with melted glass;
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